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ABSTRACT

This report describes the procedures and discusses the results of work performed by the Human Resources Research Organization during phase 1 of a U.S. Bureau of Mines project to provide a validated training system for operators of mine hoisting equipment. The objective of phase 1 was to develop the specifications for a training system that will provide mine hoist operators with the skills and knowledge they require to carry out the responsibilities of their job safely and effectively. The training system itself will be developed and validated during phase 2 of the contract. During phase 1, the following seven tasks were completed: (1) a project plan was developed and approved; (2) visits were conducted to 11 mine sites and a hoist manufacturer; and it was determined that little formal instructional materials were available; (3) a job/task analysis of the duties of a mine hoist operator was conducted; (4) knowledge and skills training objectives were developed from the job task analysis; (5) instructional strategies were selected for accomplishing the training objectives; (6) trade-off studies were conducted to determine which strategies showed the most promise; and (7) this phase 1 report was prepared describing the procedures followed in conducting the project and the rationale for the recommendations contained in it. The project operators believe that by establishing a formal training system, the overall training of mine hoist operators may be accomplished in less time while ensuring that all training requirements are met. (KC)

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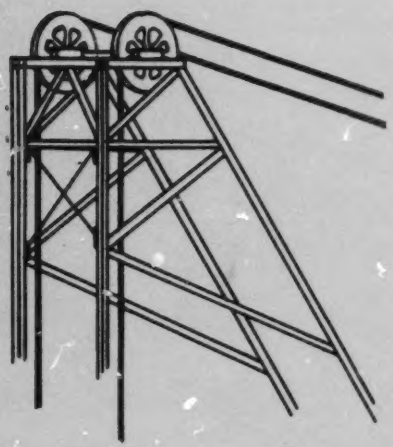

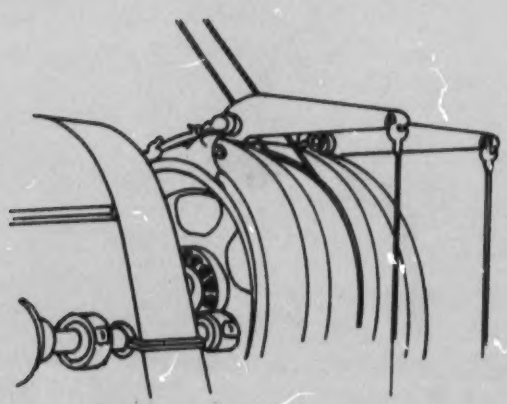

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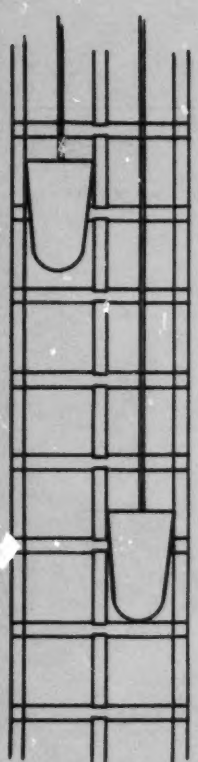

Phase I Report

Bureau of Mines
Contract No. H0387003

Paul Loustaunau and Richard Rosenblatt

November 1978

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HumRRO
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FOREWORD

This report is a statement of the work performed in Phase I of the "Development of a Training System for Mine Hoist Operators." The objective of the work in Phase I is to research the need for and the desirability of such a training system and to develop the specifications for the system. The specifications define the material to be included, the format of the training materials, and the manner of presentation. Development and validation of the training system will be the objective of Phase II.

The work for Phase I was performed by personnel of the Eastern Division of the Human Resources Research Organization (HumRRO). Principal Project personnel are:

Mr. Paul Loustaunau, Project Director

Mr. Richard Rosenblatt, Educational Specialist

Ms. Adrienne Masters, Research Assistant

Mr. John Kelly, Mining Consultant

Considerable assistance in the data gathering task of this Project was received from the safety, maintenance, engineering, and hoist operating personnel of the mining companies listed in Figure 1, page 7, of this report.

This work was ordered by the Bureau of Mines under Contract No. H0387003. Mr. W.J. Wiehagen of the Bureau of Mines is the Project Officer.

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INTRODUCTION

This report discusses the results of work performed by the Human Resources Research Organization (HumRRO) during Phase I of the U.S. Bureau of Mines Contract HO387003. The objective of the complete contract is to provide a validated training system for operators of mine hoisting equipment. The objective of Phase I is to develop the specifications for a training system that will provide mine hoist operators with the skills and knowledges they require to carry out the responsibilities of their job safely and effectively.

The training system itself will be developed and validated during Phase II of the contract.

Phase I is divided into seven tasks:

- Task I - Formulate the project Plan.
- Task II - Determine the training materials that are available.
- Task III - Conduct a mine hoist operator's job task analysis of the duties of the mine hoist operator.
- Task IV - Develop training objectives.
- Task V - Develop instructional strategies.
- Task VI - Conduct trade-off studies for the developed strategies.
- Task VII - Prepare the Phase I Report.

During Task I, the plan submitted in the HumRRO proposal was reviewed and, with minor revisions, determined to be satisfactory.

In Task II, project team members visited eleven mine sites and a mine hoist manufacturer, and attended two seminars on mine hoist new developments to identify and collect training materials, Little formal instructional material was available.

During Task III, project team members interviewed personnel at the mine sites responsible for operating, maintaining and inspecting the hoists. The data that was gathered was used to prepare the job task analyses.

In Task IV, knowledge and skills training objectives were developed from the job task analyses performed in the previous task. These objectives were reviewed with persons who had been interviewed at the mine sites.

In Task V instructional strategies were selected for accomplishing the training objectives. In Task VI trade-off studies were conducted to determine which strategies showed the most promise. In Task VII this report was prepared and describes the procedures followed in conducting the project and the rationale for the recommendations contained therein.

It is quite evident that the mine hoist operator needs training. He is responsible for the safe and effective operation of a powerful, complex, and vital machine. The hoist provides the only means of access to the mine for the miners and the machines and materials that they use. It also provides the only means of transporting the mine products from the mine working levels to the surface. A breakdown of the hoist not only stops production, but it may also result in stranding the miners underground.

During our visits to the mine sites and our interviews with hoist operating, maintenance and inspection personnel, it was evident that thorough training was being provided. Only in a few cases, however, was there any evidence of a formal training program. The apparent standard procedure was to assign the trainee to an experienced hoist operator who would teach the trainee "all he knew."

We believe that our major contribution to the training of hoist operators will be in organizing the training. By establishing a formal training system the overall training may be accomplished in less time while assuring that all training requirements are met.

TASK I: FORMULATE THE PROJECT PLAN

The initial meeting between the HumRRO staff members assigned to this project and the Bureau of Mines Project Officer, Mr. William Wiehagen, occurred on the 7th of March at HumRRO in Alexandria, Virginia. The Project Director, Mr. Loustaunau, the Educational Specialist, Mr. Rosenblatt and the Research Specialist, Ms. Bercini attended the meeting. Several topics were discussed.

The first topic was the effect that recent events will have on our conduct of the project. One such event was the Federal Mines Safety and Health Act of 1977. This Act was passed and approved by Congress in March of 1977. The new Act superceded and cancelled the Federal Coal Mine Safety Act of 1969 and the Federal Metal and Non-Metallic Mine Safety Act of 1966.

The Act transfers the Mine Enforcement and Safety Administration (MESA) formerly a part of the Department of Interior under the Bureau of Mines, to the Department of Labor. MESA will now be known as the Mine Safety and Health Administration (MSHA). MSHA will enforce all federal regulations in both coal mines and metal and non-metallic mines.

The new Act requires that mine owners, leasees, or other operators establish a safety and health training program for employees, to be approved by the Secretary of Labor. A Federal Mine Safety and Health Administration Advisory Committee has been formed and is currently developing standards which will implement the terms of the Act. Interim rules were promulgated in the 10 March, 1978 Federal Register. The proposed permanent rules for Section 115 of the Act, which covers the training and retraining of miners, were published in the 18 July, 1978 Federal Register. The public hearings for these proposed rules have been scheduled for mid-August. We plan to remain informed on the status of these rules. Any sections which specifically apply to mine hoist operators will be considered when we begin Phase II of the project.

A second event which affected the conduct of the project was the soft coal strike. Many of the coal mines were shut down in early December and had not yet reopened at the time of this meeting. We had intended to make our initial data gathering visits to coal mines in the West Virginia and Pennsylvania area. Because of the coal strike we confined our initial activities to metal and non-metallic mines. We did visit two coal mines later.

A second topic discussed in the planning meeting was of technical matters that we will need to consider while conducting the project. Examples include the differences in the responsibilities of the hoist operator, the role of maintenance and inspection personnel, the different types of mine hoists, the different uses of mine hoists, the differences in mines themselves, i.e., single level and multi-level mines, the slope and the vertical shaft mines, different hoist motor drives, and the differences in power supplies. All of these features must be covered to some degree in the course. These differences reinforced our intention in the original proposal to use a modularized concept for the instructional material. Each mine operator will then be able to select those modules that apply to his installation.

A third topic concerned the availability of training material for hoist operators. Mr. Wiehagen provided us with some training materials. One was a training course similar to one that Mr. Kelly had given us earlier. The emphasis of that course is on safety features and practices and hoist components. It does not go into enough depth in operational procedures, however. Two others were the American National Standard for the handling and use of wire rope, and a "Wire Rope Manual." These contained good technical information that will be included in the course. The last item was a copy of a study, "Mine Hoisting Inspection, Maintenance, and Safety," prepared for the Bureau of Mines by Battelle Columbus Laboratories in 1975. It too contained good technical information regarding safety, hoist construction, maintenance and inspection.

The next topic discussed covered the applicability of the training system. The training is intended for hoist operators in existing mines; it is not intended for hoist operators in shaft sinking and shaft drilling.

The final topic was on administrative matters. The monthly reports are to be an account of what was actually accomplished during the past month, what was originally planned, the discrepancies, how we intend to cope with these discrepancies, what we intend to cover during the next reporting period, any problems that we forsee in the forthcoming period, and our proposed solution to these problems. The rationale for conclusions and recommendations are to be confined to the Phase I report.

Finally the Project Officer stated that in light of the emphasis on training in the Federal Mine Safety and Health Act, he would have no objection to our accelerating the project. We will complete Phase I about 2-3 weeks ahead of the proposal date.

The plan for Phase II that we included in the proposal was a tentative one. We briefly discussed the plan and concluded that we would hold a similar meeting at the start of Phase II for its review.

In conclusion we reached complete agreement on schedule, procedures, reporting requirements, and the general plan for conducting the project.

TASK II: EVALUATION OF PRESENT TRAINING METHODS

TASK III: PERFORM THE JOB TASK ANALYSIS

Tasks II and III were conducted concurrently. Data was gathered for both tasks during the site visits and these data were analyzed on our return.

CONDUCTING THE SITE VISITS

During Phase I of the project, members of the HumRRO team visited 11 mine sites, and observed the operation of 25 hoists. Hoist operators, hoist mechanics, and electricians were interviewed.

The objectives of the visits were to:

- Collect training materials already in existence.
- Collect data to be used in conducting job task analyses of the responsibilities of the Mine Hoist Operators.
- Interview personnel responsible for training to obtain their ideas on feasible methods and media to be used in Phase II of the project.

Preliminaries

Arrangements were made for members of the HumRRO staff to visit the mine sites, listed in Figure 1. The Project Director visited Nordberg Manufacturing, Inc. in Milwaukee, Wisconsin and the Mining Research Center, Bureau of Mines Office, in Spokane, Washington, in order to obtain supplementary general information concerning mine hoists and their operation.

In preparation for these visits, members of the HumRRO team developed three forms, which appear in Appendix A, namely:

- "Respondent Background Information Form"—used to gather information during interviews with mine employees. The information enabled us to determine the type and degree of formal and informal training that had been provided for mine hoist operators at the visited mines.

Mine Visited	Location	Mine Type	Number and Type of Hoists
TRIP I			
FMC Mine	Green River, WY	Single level Shaft	1 - Friction (Koepe Wheel) 1 - Double Drum
Allied Chemical Corp. Mine	Green River, WY	Single level Shaft	1 - Friction (Koepe Wheel) 1 - Double Drum
Stauffer Chemical Mine	Green River, WY	Single level Shaft	2 - Double Drum
Texas Gulf Sulfur Mine	Granger, WY	Single level Shaft	2 - Double Drum 1 - Single Drum
Kaiser Steel Corp. Mine	Sunnyside, UT	Multi-level Slope (8°) Shaft	2 - Double Drum 1 - Single Drum
Bunker Hill Mine	Coeur D'Alene, ID	Multi-level Slope (50°)	2 - Double Drum 1 - Single Drum
Sunshine Mine	Coeur D'Alene, ID	Multi-level Shaft	I - Double Drum I - Single Drum
TRIP II			
Morton Salt Company	Week Island, LA		Double Drum Single Drum
Diamond Crystal Salt	New Iberia, LA		Double Drum Single Drum
Cities Service Mine	Copperhill, TN		Double Drum - two skips Single Drum
Island Creek Coal Co.	Keen Mountain, VA		Koepe Wheel - two skips Single Drum

Figure I—**MINE SITE VISITS**

- "A Mine Hoist Characteristics" survey sheet—used by the HumRRO staff in categorizing the specific physical characteristics of the hoist(s) at each mine. This data was used to note similarities and differences among the mines visited.
- Task Analysis Sheet"—used for collecting data on the duties and responsibilities of the mine hoist operators.

Collecting Training Materials

We found that there were no union-sponsored hoist operator training programs. There was a MESA developed program that dealt primarily with mine hoist safety features but contained little material on hoist operations.

Few formal training materials could be found at the mine sites. The training of operators at all mines was accomplished on-the-job, under the supervision of a trained operator. The formal materials that we did find were: a check-off list of training items to be completed by each trainee (items such as communication, indicators, etc. were checked off by the trainer as soon as the trainee showed adequate proficiency in the particular tasks being undertaken); a job description; and maintenance check-off lists for tasks such as lubrication, safety checks, and adjustments of equipment.

In the course of the visits we found that some states have special "requirements" for mine hoist operator qualifications. An investigation disclosed, however, that in most states the only requirement was a physical examination. Three of the states contacted required a written examination which would demonstrate knowledge of the hoist and hoist operation safety features. Illinois had the most stringent requirements, and required a basic knowledge of material handling procedures, electrical installations, wire rope, and other information related to the hoists.

The HumRRO team also noted that there was no suitable text to provide adequate descriptions of all mine features, in particular, the hoist electrical system. Although some such material is available on new hoists from equipment manufacturers, none could be located for some of the older hoists. Since these older hoists will continue to operate for many years, the training system will need to cover their features. The manufacturers' materials were not considered suitable for use in this course without revision. They are basically engineering texts and are not designed to be used for the training of a hoist operator.

The only other text on hoists that we could find was "Mine Plant Design" by Professor Staley of the University of Idaho, published in 1949. This book is now out of print. The material that it contained on hoist controls was not up-to-date. It was also an engineering text and in addition was rather brief.

In short, few training materials or text books appear to be available for mine hoist operators. We have concluded that the skills used by the hoist operator are most effectively developed through "hands on" use of the equipment during on-the-job training. We have also concluded that detailed knowledge of how the hoist functions and its

characteristics is essential for competent and safe job performance. This type of knowledge is acquired more effectively in a formal training environment (classroom, self-study, etc.) with texts, visual, and other training aids.

Conducting Job Task Analysis

The HumRRO team interviewed the hoist operators, hoist mechanics, and electricians and engineers in 11 mine sites to obtain data which would help determine the jobs, tasks, and subtasks performed by hoist operators. Although the physical details of each mine were different (some were more automated than others, for example), the job objectives and tasks were found to be basically the same. Variations present in the subtasks performed by operators existed, but were minimal.

Insofar as was practicable, the task analysis was divided into the following categories, classifying responsibilities accordingly:

- tasks and subtasks performed when taking over at the beginning of a shift;
- tasks and subtasks performed while getting the men and materials to sites for the day's work;
- tasks and subtasks performed while getting ore and muck out of the mine;
- tasks and subtasks performed while securing the hoist at the end of the shift;
- tasks and subtasks concerning housekeeping, adjustment of markings on the depth indicator, test of Lilly Control, and other responsibilities performed by the hoist operators;
- tasks and subtasks concerning maintenance, such as, wire rope inspection, sheave inspection, and hoist equipment lubrication;
- tasks and subtasks performed during emergencies.

Depending upon the organization of each particular mine, hoist operators might be responsible for some of the maintenance and inspection activities.

Minor variations in subtasks or responsibilities will not pose a problem for developing the course. The instructional materials will be modularized to account for individual variations.

A copy of a portion of the Job Task Analysis forms with a brief statement of skill and knowledge requirements for each Task/Subtask appears in Appendix A.

TASK IV: DEVELOP TRAINING OBJECTIVES

Data from the Job Task analyses were utilized to develop the training objectives. For each task and subtask to be performed by the hoist operator, we identified the corresponding skill/knowledge requirements. We developed training objectives from these skill/knowledge requirements.

The training objectives for the following activities have been grouped together.

Start of shift

Hoist Lubrication

Inspect Wire Rope

Service Hoist Operation - Manual

Production Hoist Operation - Manual

Production Hoist Operation - Automatic

Slope Mine Production Hoist Operation - Manual

End of Shift

Emergency Procedures

Evacuation Procedures

The objectives for the above activities appear on the following pages.

Training Objectives
for
START OF SHIFT ACTIVITIES

Knowledge	Skill
Know the location and function of the main power switch on the power distribution board.	Be able to energize the power distribution board.
Know how to start the motor generator set or SCR rectifier if hoist is so equipped.	Be able to start the motor generator set or SCR rectifier and provide D.C. power, if needed, to the hoist.
Know the location of critical wiring; how to visually check wiring and know when maintenance is required.	Be able to inspect wiring and locate burnt ends, loose connections, frayed or broken wires.
Know how to check hoist structure and drum for cracks, appearance of loose bolts, raised nuts or scored points.	Be able to locate and identify loose bolts on hoist anchorage and housing, and cracks in the drum and structure.
Know the location and normal appearance of brake mechanisms.	Be able to identify mechanical defects in brakes; leaks in the line.
Know the normal appearance of the safety cable and the proper amount of slack.	Be able to discern abnormalities in the appearance of the safety cable.
Know the communication systems and communication procedures.	Be able to test and utilize all forms of the communication system in the mine.
Know how to contact supervisor.	Be able to locate the supervisor by using the communication system.
Know how to contact the maintenance electrician.	Be able to use the communication system of the mine in accordance with standard operating procedures.
Know the location and function of the "deadman switch" if hoist is so equipped.	Be able to operate the "deadman switch" according to standard procedures.
Know the location and function of the clutch operating mechanism and the safety precautions to be observed in its use, if hoist is so equipped.	Be able to engage and disengage either clutch through the clutch operating mechanism.
Know the location of the hoist motor controller, the direction to move it to hoist and to lower, and the appropriate position of the controller for start, accelerate, cruise, decelerate, creep and stop.	Be able to apply power to the hoist in the requisite amounts through all phases of hoisting and lowering.

START OF SHIFT ACTIVITIES (cont'd)

Knowledge	Skill
Know the location of the brake control lever and the approximate position for hold securely, allow slight slippage, slow hoist's movement, fully released.	Be able to operate the brake through all phases of hoist operation.
Know the Bell Code.	Be able to receive and send information via the Bell system.
Know the location of the Ammeter, how to read it, and the limiting values of current flow.	Be able to read an Ammeter.
Know the appearance of abnormalities in the wire rope.	Be able to discern abnormalities in the wire rope.
Know the permissible rope speeds and Ammeter readings through all phases of hoisting and lowering.	Be able to read the rope speed meter and Ammeter.
Know the normal appearance and sound of the hoist while running.	Be able to discern abnormalities in appearance and noise of the hoist while running.
Know how to brake the motion of the conveyance electrically, if hoist is so equipped.	Be able to utilize the electrical braking features of the hoist.
Know the symbols used in marking the depth indicator and in marking the drum to indicate the depth of the conveyance.	Be able to determine the depth of the conveyance by the markings on the depth indicator and hoist drums.
Know how high to raise LILLY Control balls to cut-off power.	Be able to determine at what height of the balls LILLY Control should activate.
Know location of switch to restore power--know location and type of indicator that shows power is ON/OFF.	Be able to restore power to hoist. Be able to determine that power to the hoist has been cut off.
Test Overwind Controls.	
Know how to raise/lower cage/skip above/below dump position/load position.	Be able to operate controls to raise/lower cage.
Know position and operation of the over-travel bypass switch.	Be able to move skip/cage to its normal operating position.
Know point on depth indicator/hoist drum where over-travel controls are to cut off power.	Be able to determine from the position of the cage/skip that the power should be ON/OFF.

START OF SHIFT ACTIVITIES (cont'd)

Knowledge	Skill
Know the procedure for blocking the conveyance to test the dogs and slack rope cut off; know how to slack the rope and the amount of slack that will cut off the power.	Be able to block the conveyance to prevent downward movement and test the operation of the slack rope cut off and the safety dogs.
Know how to follow the standard logging procedures and the location of the log book.	Be able to enter the findings of the inspection check.

Training Objectives
for
DETERMINING THAT HOIST IS LUBRICATED

Knowledge	Skill
Know how often and how to inspect the grease reservoirs of the automatic and the installed manual systems.	Be able to perform the inspections of the grease reservoirs of both the automatic and installed manual systems.
Know the proper amount of grease to be in the reservoir.	Be able to determine when reservoirs are full.
Know the type of grease to use for refilling and where it is stored.	Be able to replenish low supply of grease in reservoirs.
Know how to assure that the greasing systems are operational.	Be able to test the greasing systems.
Know how to contact mechanic for assistance.	Be able to use the communication systems of the mine.
Know how to inspect the lubrication points of the automatic and installed manual systems.	Be able to identify appearance of sufficiently greased parts.
Know how to follow standard company logging procedures.	Be able to record the lubrication activities in the log book.
Know the location of points to be greased by a portable grease gun.	Be able to determine the parts of the hoist to be lubricated with a portable grease gun.
Know the location of the portable grease gun and the type of grease to use, and how to fill the gun.	Be able to locate and fill the portable grease gun.
Know how to apply grease to the lubrication points.	Be able to operate the portable grease gun.
Know when it is necessary to add oil in reservoir.	Be able to read the markings on dipstick indicating level of oil.
Know type of oil to use, where it is stored and how to replenish oil supply in reservoir.	Be able to locate "refill" port and be able to add the proper oil to reservoir
Know how to check the pump to assure it is operating properly.	Be able to read the oil pressure gauge and be able to discern normal appearance of pump and permissible oil pressure reading.
Know how to assure that sufficient oil flows through bearings.	Be able to locate and inspect sightglass at each bearing. Be able to determine normal flow of oil at each bearing.

Training Objectives
for
OILING THE ROPE

Knowledge	Skill
Know the location of lubricant and applicator	Be able to identify the lubricant and its applicator.
Know the type of lubricant and method of application.	Be able to set up the hoist for rope lubrication and to apply the lubricant.
Know the communication procedures and systems to be used between the oilers and the hoist operator.	Be able to communicate with the oilers during this procedure.

Training Objectives
for
INSPECTING WIRE ROPE

Knowledge	Skill
Know the bell code. Know the applicable regulation (Federal, State, Company) that states the rope speed, the time interval, and the sampling pattern for conducting the rag test for broken wires.	Be able to signal the hoistman when ready for the rope to start moving. Be able to wrap a rag around the rope and hold it tight enough to stay in place, yet loose enough to detect a broken wire.
Know the type of solvent to use; where to get the solvent and how to apply it; how much lubricant needs to be cleaned off in order to perform a thorough inspection.	Be able to apply the solvent to the rope and remove the lubricant.
Know how the diameter of wire rope is measured. Know the definition of a lay of rope and of crown wear.	Be able to measure the diameter of the rope, the length of a lay, and a length of crown wear.
Know the logging procedures.	Be able to record the readings in the log book.

Training Objectives
for
SERVICE HOIST OPERATION (MANUAL)
Shaft Mines

Knowledge	Skill
Know the Bell Code.	Be able to distinguish the number, grouping and order of Bell signals.
Know components of the communication systems and the standard procedures for operating the communication systems.	Be able to use the telephones and other communication systems.
Know the location of the controller, the direction to move it for hoisting and for lowering, and the position of the controller at brake release, accelerate, cruise, decelerate and stop.	Be able to move the controller to apply the desired amount of power as determined by load, rope speed, and the immediate use of the conveyance.
Know the location of the manually applied brake lever and how it operates, its position when fully released, when fully locked, and the positions for slowing.	How to set and release the brake and how to slow the conveyance in varying degrees by proper positioning of the brake lever.
Know the location and function of the Ammeter and the normal minimum and maximum readings permitted in all phases of hoist operation, i.e., starting, acceleration, cruise, deceleration, stop.	Be able to read the Ammeter and coordinate the reading with motor controller and brake lever movements and rope speed.
Know the location and function of the depth indicator and the meaning of the markings thereon.	Be able to determine depth of the conveyance from the markings on the depth indicator.
Know the depth marking on the hoist drum.	Be able to determine the depth of the conveyance from the markings on hoist drum.
Know the normal operating noise of the hoist.	Be able to discern abnormal noises when the hoist is operating.
Know the purpose and function of indicator lights, including fault boards within the hoist area.	Be able to determine the hoist/mine condition as indicated by lights in/near the hoist controls.
Know the appearance of abnormalities in the wire rope.	Be able to discern abnormalities in the wire rope.
Know the location of the rope speed meter and the permissible rope speed for each occasion.	Be able to read the rope speed meter and determine if the rope speed is within permissible limits.
Know the location of the control for dynamic braking and the dynamic braking process for the hoist.	Be able to reduce the speed of the hoist to creep speed through dynamic braking.

SERVICE HOIST OPERATION (MANUAL) (cont'd)

Knowledge	Skill
If the hoist is equipped with a clutch, know the location of the clutch operating controls and the engaged and disengaged positions of the controls. Also know the functions of the interlock, between the clutch and brake operating mechanism.	Be able to engage and disengage the drum clutch(es).
Know the position, function and indicator for Emergency STOP and power re-set.	Be able to remove power from the hoist and to return the hoist to normal.
Know the function and location of the Manual/Automatic selector switch if provided.	Be able to switch power from Automatic to Manual.
Know the location and function of the Automatic Selector switch and Start button.	Be able to switch from Manual to Automatic.

Training Objectives
for
PRODUCTION HOIST OPERATION (MANUAL)
Shaft Mines

Knowledge	Skill
Same as for Service Hoist Operations, but add the following:	
Know the markings on the depth indicator that show that the conveyance is approaching the dump point.	Be able to observe that the conveyance is approaching the automatic trip device at the dump point.
Know the motor control procedures to follow as the conveyance approaches the dump point and is emptied.	Be able to hold conveyance stationary while it is automatically being dumped.
Know how to hold the conveyance at the dump point using the motor controller.	Be able to prevent lightened skip from going into over-travel.
Know how to lower conveyance to the operating level.	Be able to return conveyance to landing and resume operations.

Training Objectives
for
AUTOMATIC OPERATION
REMOVING ORE
Shaft Mines

Knowledge	Skill
Know the location and operation of the Automatic Mode selector switch.	Be able to put the hoist in the Automatic mode.
Know the communication procedures and systems to be used when hoist is in automatic operation.	Be able to communicate between hoist operator, skip tenders and other personnel.
Know the location and function of the switch that starts the hoist in automatic operation.	Be able to start the hoist in automatic operation.
Know the procedures for placing one skip at the dump position and one skip at the working level.	Be able to raise one skip to the dump level and the other skip to the load level.
Know the engage/disengage clutch procedures if hoist is so equipped.	Be able to use the clutch(es) if necessary for the above.
Know the location and indicating signal that requires use of the Emergency Stop switch.	Be able to recognize faulty operation that requires hoist to be stopped.
Know the Restart procedure.	Be able to restart the hoist.

Training Objectives
for
SLOPE MINE PRODUCTION HOIST OPERATION (MANUAL)
Raising the Loaded Cars

Knowledge	Skill
Know bell code and standard procedures to operate communication system.	Be able to distinguish the number, grouping and order of bell signals.
Know location of controller lever and the direction to move it for start, accelerate, cruise, decelerate, and stop.	Be able to move control lever to apply and control power needed for trip.
Know location and function of deadman override; know how and when to operate.	How to engage deadman circuit.
Know how to position controller lever to take up slack in rope.	Be able to operate controller to assure smooth and even upward trip for men.
Know the normal sounds of hoist motor and drum.	Be able to discern when drum and hence man trip reaches cruising speed.
Know location, function and operating procedures of the manually applied brakes (from fully released through fully set).	How to release and set brakes; how to slow conveyance in varying degrees by proper positioning of brake levers.
Know location and function of rope speed indicator and permissible rope speed for each occasion.	Be able to read rope speed indicator.
Know location and function of depth indicator.	Be able to read depth indicator, discern markings thereon, and determine the position of the conveyance.
Know how and why to position controller to neutral at level places in mine shaft.	Be able to control slack in the rope at level places so conveyance won't run over slack.
Know the location of the magnetic and hydraulic brake levers and procedures for using them.	Be able to reduce speed of the trip smoothly and safely.
Know the location and how to operate the manual brake levers.	Be able to prevent trip from rolling off the track; and to position car at dump point.

Training Objectives
for
SLOPE MINE PRODUCTION HOIST OPERATION (MANUAL)
Lowering the Empty Cars

Knowledge	Skill
Know bell code and standard procedures to operate communication systems.	Be able to distinguish the number, grouping and order of bell signals.
Know the location of the controller lever and the direction to move it for start, accelerate, cruise, decelerate and stop.	Be able to move the controller to apply and control the amount of power needed for trip.
Know the location and function of the deadman override; know how and when to operate.	How to engage deadman circuit.
Know the location and function of the manually applied brakes and how they operate (such as position when fully released, fully locked, and slowing position).	How to set and release brakes and how to slow conveyance in varying degrees by proper positioning of brake levers.
Know location and function of rope speed indicator and permissible rope speed for each occasion.	Be able to read rope speed indicator.
Know location and function of depth indicator and the meanings of markings thereon.	Be able to read the depth indicator and discern the markings on it.
Know the location of the dynamic and hydraulic brake levers and procedures for using them.	Be able to control speed of the hoist.
Know location and function of depth indicator to determine which drop-in point is designated by rope rider bell signal.	Be able to distinguish location of drop-in point from bell signal.

Training Objectives
for
END OF SHIFT ACTIVITIES

Knowledge	Skill
Know how to load, raise and dump waste, etc. with each skip at the end of the shift.	Be able to load, raise, and dump waste at end of shift with each skip.
Know the position for skips during non-working periods.	Be able to place skips in their non-working period positions.
Know the motor control, and braking procedures, to move the conveyance to its designated position at the end of the shift.	Be able to position conveyance clear of the landing level; brake on full and power to neutral.
Know how to secure skips at the end of the shift, i.e., power control to neutral, check that skips balance, set brake.	Be able to secure skips at the end of the shift.
Know the location and operation of power switch.	Be able to disconnect the power to distribution board.
Know the standard logging and reporting procedures.	Be able to inform relief hoistman of problems encountered, power drain and general hoist condition.

Training Objectives
for
EMERGENCY PROCEDURE
LOW AIR PRESSURE ON BRAKE SYSTEM

Knowledge	Skill
Know the normal hydraulic pressure and position of the hydraulic accumulator when the air pressure is normal.	Be able to determine that the air pressure is low.
Know how to turn off the hydraulic pump, i.e., location and operation of the ON/OFF switch.	Be able to operate the hydraulic pump ON/OFF switch.
Know the location of the air hose and where and how it connects to the air reservoir and the compressor.	Be able to use the air hose to connect the air compressor to the air reservoir.
Know the location of the air gauge, the air bleed-off valve and how to open/shut the air bleed-off valve.	Be able to bleed the air out of the reservoir--to 0 lbs. pressure--and close the bleed valve.
Know how to line up to charge air reservoir, i.e.: Open compressor air value Open reservoir air valve Open the air hose valve	Be able to line up the air system to charge the air reservoir.
Know how to start air compressor, run it until air pressure is normal and stop compressor (manual or automatic).	Be able to start compressor, determine when air pressure is normal and stop compressor.
Know how to close compressor, air reservoir, and hose valves and remove and store hose.	Be able to return the hydraulic system to its normal operating condition.
Know how to restart the hydraulic pump.	Be able to restart the hydraulic pump.

Training Objectives
for
EMERGENCY PROCEDURES FOR
OVERTRAVEL AND OVERSPEED

Knowledge	Skill
Overtravel:	
Know the location and how to operate the back-off switch.	Be able to engage and disengage the back-off switch.
Know how to move the cage/skip within the operating area.	Be able to use the controller to move the skip within the operating area.
Overspeed:	
Know the procedure for putting the controller into the neutral position.	Be able to put the controller to the neutral position when LILLY cuts off power.
Know the procedure for setting the brake.	Be able to set the brake.
Know how to reset the "power on" switch.	Be able to reset the "power on" switch.

Training Objectives
for
EVACUATION PROCEDURES

Knowledge	Skill
Know the circumstances requiring the evacuation of the mine.	Be able to determine if mine evacuation is necessary.
Know the characteristics and limitations of the self-contained breathing unit.	Be able to use the self-contained breathing unit.
Know the procedure for withdrawing personnel from the mine.	Be able to carry out the hoistman's duties in the evacuation of personnel.
Know the location and operation of the power cut-off switch.	Be able to de-energize the power distribution board.
Know the names of personnel who are authorized to enter the mine during or immediately after an evacuation.	Be able to prohibit the entry of all unauthorized personnel into the affected area.
Know the safety regulations for fire prevention.	Be able to enforce the safety regulations for fire prevention.

TASK V: SELECT THE INSTRUCTIONAL STRATEGY

Procedure for Selecting Instructional Strategy

The selection of an instructional delivery system is an important step in the training system design process. An instructional delivery system is composed of the student and all of the elements with which he interacts to achieve instructional goals. The structure of this delivery system largely determines how the information pertinent to training is to be organized and presented to the student. The choice of the delivery system affects not only training effectiveness but also the costs of instruction. For example, in the systems engineering approach, instructional delivery system choices are determined from trade-off studies which consider the relevant alternatives for training and their associated costs. Choosing the delivery system with the optimum mix of instructional media is difficult to accomplish in an intuitive, informal manner. A systematic approach to media and instructional delivery system selection, formalized in the training system design process, is required.

Prominent factors that must be considered include the nature of the tasks and task structure, the learning strategies appropriate to these tasks, the media types available for instruction, and the procurement, operating and updating costs of alternative media mixes. Other prominent factors are the state of development of proposed media approaches, resources required for courseware development, and the characteristics of the anticipated student population.

The process of selecting instructional delivery systems is formally initiated when the training objectives for a proposed training system have been received; these training objectives are an input to the process. Starting with this set of objectives, a sequence of steps is carried out for deriving appropriate learning strategies, identifying instructional delivery systems capable of supporting these strategies, and determining costs associated with these delivery systems. The output of this effort is a description of an optimum instructional delivery system for accomplishing the training objectives. The steps employed in arriving at the optimal system are summarized below.

CHOOSE LEARNING ALGORITHMS FOR TRAINING OBJECTIVES

An algorithm is a precise, generally comprehensible prescription for carrying out the defined sequence of elementary operations needed to solve any problem belonging to a certain class. Therefore, a learning algorithm is a step-by-step prescription for a student to follow in order to learn any specific task in a class of learning tasks, such as procedure following or decision making. It is a general sequence for use with all similar training objectives. Learning algorithms have been prepared for the more common types of cognitive, perceptual and motor training tasks. Each training objective is matched with one of the learning algorithms.

Training objectives for the mine hoist operator course were derived from task analyses of 25 hoisting operations at 11 mines, and prepared by project personnel who visited these mines. The hoisting operations reviewed represent a comprehensive sampling of hoist types, mine products, mine size, and mine layout.

The product of the task analysis phase was a series of detailed descriptions of tasks carried out by operators at each hoist studied. Comparison of these descriptions across hoisting operations suggested that the hoistman's job can be divided into eight generic task categories:

(1) Inspection of hoist components prior to start of shift;
(2) Lubrication of hoist components prior to shift;
(3) Operate hoist with empty skip/cage prior to shift in order to test hoist controls and safety devices.
(4) Operate hoist to raise/lower men and materials between mine collar, working levels, and sump;
(5) Operate hoist to raise product from working level to "dump" or "tipple".
(6) Operate hoist to lower empty skip from dump to working level;
(7) Operate hoist to place in "release" state at end of shift;
(8) Emergency procedures.

Level of operator involvement in each task category and complexity of component behaviors varied among the studied mines. It was nonetheless clear from our analysis that regardless of the mining operation, common behavioral elements occurred within each task category for all hoist operators. Inspection and lubrication involved detection of visual and auditory anomolies on the hoisting apparatus, followed by routine prescribed procedures. Each of the "operate hoist" categories involved specified sequences of control manipulation related to starting, accelerating, crusing, decelerating, and stopping the hoist. Furthermore, controls and instruments were generally similar for any given

sequence. For example, accelerating the skip or cage requires the use of a motor control lever to effect and modulate acceleration, a rope speed indicator to monitor acceleration, and a depth indicator to indicate when to start and cease acceleration.

Once task categories and their component behavior sequences were identified, requisite skills and knowledge were defined. Knowledge refers to the ability to recall equipment nomenclature and function, and determine which equipment to use for a specific task. Skill refers to the ability to integrate knowledge with appropriate behavior in order to successfully complete a task. The task descriptions, the purpose of each task, and the skill and knowledge requirements are in Appendix A.

Learning algorithms which could be applied to hoist operator training objectives were selected from those algorithms studied and tested by Braby and his colleagues for the Navy (Braby, et al., 1976). HumRRO staff chose the Navy approach after considering a number of instructional system development techniques; it alone contained a systematic integration of experimental and theoretical literature coupled with empirical testing and systemic revision.

Four principle types of algorithms were matched to the skills and knowledge components of our training objectives. The following paragraphs present a brief description of the function of each algorithm and outline the guidelines for constructing versions appropriate to the particular categories of objectives. "Recalling Procedures and Positioning Movement" and "Guiding and Steering, Continuous Movement" were selected for operating skills; "Detecting" is appropriate to Inspection skills; "Recalling Bodies of Knowledge" is appropriate to the knowledge objectives underlying each of the skills.

Recalling Bodies of Knowledge

This category encompasses the learning, recognizing, and recalling of verbal information needed to function in an operational setting. It includes knowledge of equipment nomenclature, functions, configurations, locations, control inputs, output displays, and the complex relationships between inputs, outputs, and possible equipment malfunctions. Most academic training is of this kind; therefore students learning these tasks have been accessible as subjects for investigators studying the learning and recall of verbal information. The following guidelines are developed from the findings of this research, and will be utilized when applicable.

1. Communicate training objectives to the student at the beginning of the training period.

2. Organize the learning material to meet the stated objectives. Organize training around important cue components (key words, formulas, or phrases) within the body of facts or principles.

3. Provide warm-up exercises prior to testing for recall of bodies of knowledge.

4. Make learning tasks relevant; i.e., similar to real-life tasks that the student will be performing on the job.

5. Compare directly similar names or other data, or separate their presentation with as much time as possible, to avoid confusion.

6. Make sure the students can differentiate between salient cues that are difficult to distinguish in the operational context before associating each with a response during training.

7. Use mnemonics (association devices) which will cause an effective reaction in the student to aid recall.

8. Use mnemonics which will aid in the association of the cue and response terms in the recall of facts or principles. Provide directions for the student to develop his own mnemonics if he can and wants to do so.

9. Arrange to use features of the real-world job setting to trigger the student's recall of associated cues which, in turn, will call to mind the knowledge he needs to perform his job.

10. Select cues which are effective for attention-getting. Select learning activities that require student involvement.

11. Guide (or prompt) the student's response, especially in the early phase of training. Later in training, reduce additional guides to match the level of guides (or prompts) in the operational setting.

12. Provide retrieval tests very similar to the tests that the student will encounter in the operational setting, for practicing recall of verbal information.

13. Require the student to make responses to demonstrate his recall of the facts or principles; this in turn, will enable measurement of his response.

14. Arrange for knowledge of results (KOR) to follow both correct and incorrect responses. Also arrange for positive reinforcement following correct recall of facts to be interspersed throughout the training.

15. Schedule KOR to be presented immediately after a response to achieve maximum effectiveness.

16. Change the order of facts and principles during practice so that each item will be learned equally well.

17. Practice should be interspersed with rest periods when training sessions include (1) the learning of large bodies of facts or (2) complex information. This is particularly useful with slow learners.

18. Individualize instruction to the maximum extent possible. In order for slow learners to reach the same level as fast learners, allow individual trainees to proceed at the pace which best suits their learning capabilities.

19. Periodically arrange for the student to compare the program's stated objectives with his status in meeting these objectives.

20. Test to determine if the student is able to correctly recall key features of the job setting which serve as cues for recalling the knowledge he needs to perform his job.

21. Prevent decay of recall by:

a. Increasing the meaningfulness of the material to be learned (relating it to the student's operational environment) and by relating the organized facts or principles to each other.

b. Requiring the student to overlearn the original material (an essential procedure to reduce forgetting).

Detecting

This task concerns the act of becoming alert to the presence of a signal that could be of special interest in the performance of a job or mission. Detecting is essentially a matter of becoming aware of certain cues, including those present in distracting backgrounds. It stops short of verifying the nature of the cues. Normally the cue is classified after it has been detected.

The early detection of defects in an operating mechanism is a significant part of an inspection and preventive maintenance program. Examples include, an operator becoming aware of a distortion of the structure of the rope being wound/unwound on the drum; a mechanic becoming alert to slight changes in the functioning of a piece of equipment indicating an emerging malfunction; an operator becoming aware of a light coming on in the fault board indicating a fault.

In these detection tasks, involving long periods of time between the appearance of significant signals, maintaining vigilance is an important part of performance.

The following guidelines apply to detecting:

1. Train the student to use systematic search procedures utilizing his appropriate senses. Use models of correct behavior, where needed.

2. Present signals from the full range of signals, the student will encounter on the job and include the different patterns of each signal source.

3. Train the student to use techniques of vigilance to:

   a. establish a mental set to search. Use instructions to establish this set and reinforce the student when he achieves a proper set.

   b. constantly monitor internal biological cues in order to determine own vigilance level (state of alertness).

   c. use, where appropriate, peripheral vision in scanning; i.e., to rely on detections made from the side of direct line of sight.

4. Train the student in detection skills according to the following schedule:

   a. Early in training use:

      (1) signals more frequent than in the operational task,

      (2) signals that are quite obvious,

      (3) different amounts of time between signal presentations,

      (4) high response rate from the learner,

      (5) immediate and continuous knowledge of results (KOR),

      (6) reward for responding to any real signal,

   b. During the intermediate stage of training use:

      (1) signals that are less frequent than in "a", but more frequent than in real life,

      (2) less obvious signals,

      (3) different amounts of time between signal presentations,

      (4) KOR on an intermittent time schedule,

      (5) specific vigilance techniques; i.e., mental set to search and monitor internal cues to state of alertness,

      (6) intermittent reward for responding to real signals,

   c. In advanced state of training use:

      (1) signal frequency similar to that in actual practice,

      (2) signals that are of the same intensity relative to the background as they would be in real life,

      (3) signals presented within different time intervals,

      (4) KOR on a schedule equivalent to that found in the job setting (describe realistic consequences for signals missed),

(5) vigilance techniques which are appropriate to the job setting,

(6) operational level of reward following correct detection.

5. Train the student to use a cue detected by one sense (such as hearing) as a stimulus to search for and detect the existence of a related cue in a second sense (such as sight) where it is possible to detect a target by more than one sense.

6. Present the student with his status; i.e., progress towards meeting the training objectives. Reward him for progress toward these goals.

7. Individualize training. Keep student practicing at each phase (or level) of the learning task until the required level (or mastery) of the job performance is achieved.

Recalling Procedures and Positioning Movement

This category combines two different types of tasks. Recalling procedures is basically a mental skill; positioning movement is a physical skill. These two skills can be combined in these guidelines because they often occur together in the operational setting. They involve carrying out routinized activity and standard operating procedures in some predetermined sequence. These skills require relatively little judgment and analysis and involve a minimum of alternative behavior. Controls and instruments are manipulated in an identifiable procedural sequence. Motor movements for control positioning are, at the outset, within the response repertoire of the student; the emphasis is placed on recalling the sequential procedures and on the accuracy of the positioning movements. An example of this is checking out a piece of communication equipment using a checklist to determine if the equipment is operating within acceptable tolerances. These common types of tasks have often been studied with the goal of improving training efficiency.

Guidelines for recalling procedures and positioning movement are listed below:

1. State clearly the behavioral objectives to be achieved. Describe how the learning materials are organized to achieve desired behavior. Relate the objectives to the student's future real-world assignments.

2. Break the positioning movement task into appropriate parts and provide subdivisions of organization for each procedure.

3. Divide the procedural steps into small parts if any of the following conditions exist:

a. Students are of low ability,

b. The procedures are complex,

c. The entire procedure is lengthy.

4. Present a demonstration of each task performance (a positioning response to a checklist cue) on an observable model.

5. Show checklist cues if appropriate and require the student to explain differences in similar cues that serve as association devices for procedures that have been confused in the past.

6. Use mnemonics which will cause an affective reaction in the student whenever possible to aid in the recall of procedures to be learned for this task.

7. Use mnemonics (associating procedural steps with imagery, rhymes, or rhythms) to aid in recalling difficult to remember steps. Provide directions for the student to develop his own mnemonics where he is able and willing to do so.

8. Direct the student to practice the following sequence of events to help him remember a chain of procedures.

   a. Explain (or perform) the procedural step which corresponds to each checklist item.

   b. Then explain or perform the procedural steps which correspond with a given group of checklist items (as many as the student can handle.) The first item of each group should overlap with the last item of the previously studied group of steps.

   c. Finally, take the entire list of all of the checklist items for the entire procedure, and explain (or perform) the corresponding procedural steps.

9. Encourage students to mentally rehearse the procedures called for by the steps in the checklist using mnemonics to aid in the recall of these procedures.

10. Ensure extensive practice early in the training by requiring the learner to:

   a. Understand the objective(s).

   b. Observe the skilled performance of a model.

   c. Strengthen the individual (or component) steps of the desired movement by practicing these steps, obtaining knowledge of results (KOR) and correcting performance errors.

   d. Integrate the steps into a smooth sequence of positioning movements by practicing the sequence of steps.

11. Provide the following conditions for corresponding stages of training:

   a. Early in training use:

      (1) immediate and frequent KOR,

      (2) immediate and frequent reinforcement,

(3) little or no operational distractors,

(4) learning material broken-down into small, easily learned parts,

(5) knowledge requirements which are relatively easy to learn,

(6) guiding or prompting of responses.

b. Late in training:

(1) use delayed and infrequent KOR,

(2) use delayed and infrequent reinforcement,

(3) increase distractors to operational level,

(4) require the recalling (or performance) of a given procedure in response to the same cues as appear on the job,

(5) the level of complexity of the procedural cues and distractor cues should be the same as on the job. Add stressful conditions equivalent to that in the operational setting,

(6) eliminate guides or prompts (other than those provided in the operational setting).

12. Make the time interval following KOR much longer than the time interval between the response and KOR, to provide time for the student to sort out errors.

13. Identify features of the operational environment which could be used as mediators to trigger the student's recall of checklist items.

14. Practice should be distributed; i.e., the timing of rest periods should be determined by the:

a. need for rest as judged by the student.

b. requirements of the specific learning material as judged by the instructor.

15. Arrange for extensive repetition (overlearning) by the student to take advantage of the internal feedback properties generated by performing these types of tasks (positioning movement) accompanied by external feedback. Simple repetitive movements may become reinforcing; i.e., the student experiences feelings in muscle and joints which he identifies as cues that he is performing the task correctly.

16. Arrange for slow learners to have a higher number of reinforcements for correct responses than the fast learners.

17. Maximize the realism of checklist items if used, and their corresponding procedural responses.

18. Periodically arrange for the student to compare the program objectives with his current status in meeting these objectives.

19. Train the student to the operational criterion; i.e., insure that acquisition of the procedural material will be equal to the level of performance required for on-the-job duties.

20. Prevent decay of recall by providing periodic refresher training for infrequently used procedures.

Guiding and Steering, Continuous Movement

This type of task concerns continuous physical response to a constantly moving visual reference. Frequently it involves controlling the path of a moving vehicle. Examples include maneuvering an automobile down a road, controlling the movement of a mine skip, and holding a ship on course using a gyro compass. Many operator jobs involve this type of behavior. Because of the high cost of vehicle control training performed on the operational systems, training methods for this type of behavior have been carefully studied to determine their effectiveness. Proprioceptive stimulation, which normally arises in the muscles, tendons, and joints, is one of the primary sources of information used in controlling the force, extent, and duration of a movement. Perceptual discrimination skills are involved, including the detection of relevant cues (via sight, hearing, touch, etc.). Models of correct behavior are usually used in the training of this task. They serve as guides and criteria for evaluating one's own behavior. These models include rules, self-directions, and cues of adequate performance. As the student's skill increases in continuous movement tasks, a high degree of internal control is developed; i.e., the routine tasks are performed smoothly with little conscious effort, and conscious control governs increasingly larger blocks of behavior.

The following guidelines have been defined for training continuous movement tasks:

1. State clearly the criterion behavior or objective to be achieved. Relate the objective to the student's future real-world assignments. Provide him with an overview of desired movements.

2. Break the task up into appropriate parts. (Use as criteria to determine the size of these parts: ability of learner, complexity, and length of task.)

3. Ensure that the critical external cues are realistic and available to the student continually during the performance of the task, particularly during the latter part of the training.

4. Provide instruction on how to scan including specific training for eye movement and where to focus.

5. Insure a high degree of realism in the operator's response in training for continuous controlling tasks.

6. Demonstrate the desired task performance.

7. Provide for extensive practice to achieve skilled performance. Practice should contain (a) understanding skill objective, (b) observing skilled performances, (c) practicing the task, (d) obtaining knowledge of results (KOR), and (e) scheduling periodic rest intervals.

8. Provide reinforcement contingent upon characteristics of the student's response so that by a process of "successive approximations," the final desired proficiency (within acceptable tolerances) is produced.

9. Give KOR concerning discrete segments of student performance, especially during early stages of learning.

10. Give positive reinforcement after correct student performance; initially, immediately after each discrete segment of performance; toward the end of training, after each maneuver or complete operation.

11. Practice on specific components when learning a complex task, as opposed to practicing on the entire task at once.

12. Practice under the varied conditions that will exist in the operational setting, if possible.

IDENTIFY INSTRUCTIONAL DELIVERY SYSTEMS FOR EACH SET OF SIMILAR TRAINING OBJECTIVES

A student must be able to carry out each of the steps in the algorithm selected for a given set of objectives. An instructional delivery system is to be selected that will enable the student to follow this sequence. The delivery system shall be capable of (1) displaying the essential stimulus characteristics of the subject matter; i.e., color, motion, sound; (2) allowing the student to respond appropriately; i.e., choose an answer or manipulate a control; and (3) providing the student with the required form of feedback and reinforcement; i.e., his test scores or a dynamic change in the performance of the system, indicating that he has performed incorrectly. All of these events are specified with the algorithms.

In the prior step, training objectives were classified and grouped according to the type of learning algorithm required to accomplish the objectives. In the present step we identify, for each group of objectives, two or more instructional delivery systems that will support the use of the required algorithm.

Tables 1 through 4 contain schematic representations of the decision process used to select delivery systems appropriate to each of the four algorithm types identified earlier. The left-hand margin of each figure describes characteristics of the instructional stimuli, training setting, and training administration that may play a role in determining the appropriateness of the several potentially relevant delivery systems listed across the top of the figures. For example, stimulus criteria for recalling bodies of materials include full and limited movement of instructional stimuli, e.g., real-time motion of a machine to be studied as opposed to stop-action motion.

Capital "X's" at the intersection of a criterion and a delivery system mean that the system can support the demands of the criterion. Thus, according to Table 1 both CAI and branched teaching machines will provide limited motion, but only CAI will provide full motion of the learning materials.

The instructional designer places check marks immediately to the right of all selection criteria which, in his judgment, must be met by candidate delivery systems. Systems which have vertical patterns of X's duplicating the pattern of checks are comparable in their applicability to the algorithm under consideration.

HumRRO's choices of selection criteria are indicated by the hand-drawn checks to the left of each table. Delivery systems which meet the criteria patterns are starred.

ESTIMATE THE COST OF ALTERNATIVE SYSTEMS

The cost of using an instructional delivery system is the total value of all resources consumed in that part of the training program supported by the system. Included are the costs of the equipment, the curriculum materials, the personnel (e.g., instructors and support personnel), the supplies consumed, the facilities supporting the use of the system, and the wages and other costs of the trainees. These costs can be estimated with the aid of a formal cost model. This model displays the cost implications of substituting one medium for another in an instructional delivery system and can also be used to compare entirely different systems.

This section addresses the question of assigning developmental and operational costs to each of the technically acceptable delivery systems. While necessary to rational decision-making, the costing step is invariably laborious and frequently hazardous especially when estimates of cost factors must be used in place of hard data. Considerable savings in time and effort may be affected and considerable precision in selection gained by the simple expedient of asking whether a given delivery system is a practical solution

Table 1

Instructional Delivery System Chart for the Algorithm

Recalling Bodies of Knowledge

Directions:

To Choose a Delivery System:

1. Place a "√" (light pencil) in boxes representing criteria (rows) that must be met.
2. Select the delivery systems (columns) that have an "X" in each row designated by a "√". These are the candidate delivery systems.

Criteria for Selecting Instructional Delivery Systems		Alternative Instructional Delivery Systems								
		Delivery Approaches Permitting the Application of All Learning Guidelines and Algorithm					Delivery Approaches NOT Permitting Complete Application of Learning Guidelines and Algorithm			
		CAI	Teaching Machine – Branching	Microfiche with Self-Scoring Tests *	Programmed Text – Branching with Self-Scoring Tests *	Audio Visual Carrel with Program Texts, AV Modules and Self-Scoring Tests	Traditional Classroom with Instructor, Overhead Projector, Texts, and Paper and Pencil Tests	Independent Study Using Textbooks, Handbooks, Tests and Workbooks *	Instructional Television Broadcast or CCTV Without Feedback, Tests	Programmed Text – Linear with Instructor Scored Criterion Test *
Stimulus Criteria										
• Visual Movement										
Limited		X	X			X			X	
Full		X				X			X	
• Visual Spectrum										
Full Color		X	X	X		X	X	X	X	
• Audio										
Voice Sound Range		X	X			X	X		X	
Full Sound Range						X				
Training Setting Criteria										
• Individual Trainees at Fixed Location		X	X	X	X	X	X		X	X
• Individual Training with Simultaneous Instruction at Many Locations									X	
• Individual Trainees with Independent Instruction at Any Location	√			X	X			X		X
• Small Group							X		X	
• Large Group at a Single Location							X		X	
• Team Setting										
Administrative Criteria										
• Site of Courseware and Special Hardware Development										
Local				X	X	X	X	X		X
Central	√	X	X	X	X	X		X	X	X
• Magnitude of Acquisition Cost										
Low				X	X		X	X		X
High		X	X			X			X	

Table 2

Instructional Delivery System Chart for the Algorithm

Detecting

Criteria for Selecting Instructional Delivery Systems	Directions: To Choose a Delivery System: 1. Place a "√" (light pencil) in boxes representing criteria (rows) that must be met. 2. Select the delivery systems (columns) that have an "X" in each row designated by a "√". These are the candidate delivery systems.	Alternative Instructional Delivery Systems							
		Delivery Approaches Permitting the Application of All Learning Guidelines and Algorithm					Delivery Approaches NOT Permitting Complete Application of Learning Guidelines and Algorithm		
		★ Operational System with Stimulated Signals, and an Instructor with Instructor Handbook	★ Simulator with Instructor and Instructor Handbook	★ Simulator with Adjunct Displays and Logic	Procedure Trainer, with Instructor and Instructor Handbook	Procedure Trainer with Adjunct Displays and Logic	Operational System with Instructor	Informal On-the-Job Training on Operational System	
Stimulus Criteria									
• Full Visual Environment		X					X	X	
• Full Ambient Sounds	√	X	X	X			X	X	
• External Stimulus Motion Cues	√	X	X	X			X	X	
Training Setting Criteria									
• Individual Trainee at Fixed Location (School)		X	X	X	X	X	X		
• Individual Trainee On-the-Job		X					X	X	
Administrative Criteria									
• Site of Courseware and Special Hardware Development									
Local							X	X	
Central	√	X	X	X	X	X			
• Magnitude of Acquisition Cost									
Low								X	
High		X	X	X	X	X	X		

Table 3

Instructional Delivery System Chart for the Algorithm

Retelling Procedures and Positioning Movement

Directions:

To Choose a Delivery System:

1. Place a "√" (light pencil) in boxes representing criteria (rows) that must be met.
2. Select the delivery systems (columns) that have an "X" in each row designated by a "√". These are the candidate delivery systems.

Criteria for Selecting Instructional Delivery Systems		Alternative Instructional Delivery Systems												
		Delivery Approaches Permitting the Application of All Learning Guidelines and Algorithm								Delivery Approaches NOT Permitting Complete Application of Learning Guidelines and Algorithm				
		★ Operational System in Laboratory with Tutor	★ Simulator with Tutor and Tests	★ Procedures Trainer with Tutor and Tests	Logic Trainer with Tutor	CAI with Photo or Operable Mockup	Teaching Machine with Photo or Operable Mockup	Microfiche w/two Photo or Operable Mockup	Programmed Text – Branching	★ Laboratory Corral with Equipment and Linear Instructional Materials	★ Operational System in Real Environment with Tutor	Texts, Lectures and Demonstrations		
Complexity Criteria														
• Difficult Motor Acts		X	X	X	X					X	X			
• Smooth Motor Performance at End of Training	√	X	X	X						X	X			
Stimulus Criteria														
• Visual Form														
Alpha-Numeric		X	X	X	X	X	X	X	X	X		X		
Pictorial, Plane					X	X	X	X	X	X		X		
Object, Solid	√	X	X	X	X					X	X	X		
• Visual Movement														
Still					X	X	X	X	X	X		X		
Full Movement	√	X	X	X	X	X				X	X			
• Audio														
Voice Sound Range		X	X	X		X				X	X	X		
Full Sound Range	√	X	X	X						X	X			
Ambient Sounds		X	X	X							X			
• Other														
Tactile Cues	√	X	X	X						X	X			
Internal Stimulus (Motion Cues	√	X	X	X						X	X			
Training Setting Criteria														
• Individual Trainee at Fixed Location	√	X	X	X	X	X	X	X	X	X	X	X		
• Individual Trainee with Independent Instruction at Any Location								X	X					
• Small Group					X							X		
• Large Group at Single Location												X		
• Team Setting		X	X	X	X						X			
Administrative Criteria														
• Site of Courseware and Special Hardware Development														
Local								X	X	X	X	X		
Central	√	X	X	X	X	X	X	X	X	X	X			
• Magnitude of Acquisition Cost														
Low								X	X	X		X		
High		X	X	X	X	X	X			X	X			

Table 4

Instructional Delivery System Chart for the Algorithm

Steering and Guiding—Continuous Movement

Directions: To Choose a Delivery System: 1. Place a "√" (light pencil) in boxes representing criteria (rows) that must be met. 2. Select the delivery systems (columns) that have an "X" in each row designated by a "√". These are the candidate delivery systems.		Alternative Instructional Delivery Systems					
		Delivery Approaches Permitting the Application of All Learning Guidelines and Algorithm				Delivery Approaches NOT Permitting Complete Application of Learning Guidelines and Algorithm	
Criteria for Selecting Instructional Delivery Systems		* Operational System, Real Environment with Instructor and Instructor Handbook	* Simulator with Motion Platform and Full Visual Field, Instructor and Instructor Handbook	Simulator (Without Motion Platform and Full Visual Field), Instructor and Instructor Handbook	Procedure Trainer, Instructor and Instructor Handbook	* Operational System, Real Environment, Without Instructor	
Stimulus Criteria							
Full Visual Environment		X	X			X	
External Stimulus Motion Cues	√	X	X			X	
Fine Movement Manipulative Acts	√	X	X	X		X	
Broad Movement Manipulative Acts	√	X	X	X	X	X	
Training Setting Criteria							
Individual or Team Training at a Fixed Location	√	X	X	X	X	X	
Individual or Team Training with Independent Instruction at Many Locations		X				X	
Administrative Criteria							
Site of Courseware and Special Hardware Development							
Local		X				X	
Central	√	X	X	X	X	X	

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to the training problem. For example, approaches which require long lead time for development may not be useful when scheduled training commencement dates do not allow a long development cycle. Consider also that trainers often resist innovations which comprise a radical departure from existing techniques; under such circumstances either adequate resources must be focused on gaining acceptance for the innovation or a more traditional approach applied.

Adopting a "practicality" orientation when viewing the various candidate delivery systems leads to the realization that operating mine hoists have been used successfully for a long time as training media for new personnel. A full fidelity simulator, for example, could be designed and constructed to represent the hardware components of a hoist and accurately reproduce the operational environment in a training setting. When operated, it becomes a dynamic model of the appearance and performance of an operating hoist, thus ensuring that all relevant motor, perceptual and cognitive components of the hoistman's job are represented during training and practice.

The use of simulators in hoist operator training would ensure that training could be conducted at no interference with mine activities; further, the possibility of damage or excessive wear on the hoist due to trainee error would be eliminated. The use of simulators, however, is not a practical alternative in this case. Although the tasks performed by hoist operators are similar for every mine, there are slight variations in equipment which alter the hoist operators' routines to some degree. It would be impractical physically as well as financially to construct a simulator which would duplicate every hoist in the country. Candidate delivery systems which involve simulators, past trainers as well as full fidelity, are therefore eliminated. If the trainee's study and practice with the existing hoist is closely monitored by an experienced hoistman, the hoist can serve as a training medium at no detriment to it's primary function of providing transportation at the mine.

Since the physical characteristics, layout, etc. of some mine hoists, particularly older pieces of equipment, may not take human factors into account, the instructional strategies must do so. For example, if a piece of equipment was not well designed from a human factors standpoint, "hands-on" training will probably need to be more frequent and more extensive to insure that training objectives will be adequately achieved.

CHOOSE COST-EFFECTIVE INSTRUCTIONAL DELIVERY SYSTEM OR MIX OF SYSTEMS.

To be cost effective a delivery system must (1) facilitate student learning of the required behavior and (2) be relatively inexpensive when compared with other systems which also provide the required learning. The training system design team chooses an instructional delivery system based on estimated training effectiveness and cost. Instructional delivery systems which both minimize resource consumption and meet training objectives are the prime candidates for incorporation into the proposed training system.

Our costing task has been greatly simplified by the limited number of practical alternatives. The delivery systems to be considered in the costing step of Task VI are:

• for Detecting	Operational system with simulated signals, and an instructor with instructor handbook.
• for Recalling Procedures and and Positioning Movement	Operational system in real environment with tutor.
• for Steering and Guiding Continuous Movement	Operational system, real environment with instructor and instructor handbook.
• for Recalling Bodies of Knowledge	Microfiche with self-scoring tests. Programmed text—branching with self-scoring. Independent study using textbooks, handbooks, tests, and workbooks. Programmed text—linear with instructor scored criterion test.

Instructional Strategy for Training Mine Hoist Operators

The training program will be divided into three parts:

I. General Hoist Description
   A. Structural Components of Hoist
   B. Hoist Operations
II. Specific Hoist Description
III. "Hands on" Operation of Equipment

Part I will provide general descriptive information that would apply to all mine hoists. It will include descriptions of the structural components of the hoist and the variations in the individual features of these components. It will also describe the step-by-step procedures that are carried out by the hoist operators in performing their jobs/tasks under normal and emergency conditions.

The instructional materials will consist of text supplemented with visual aids. There will be sets of questions within the text to reinforce the learning process. There will also be tests to be taken at completion of each learning unit. An administrative manual will be provided for the trainer. It will contain the instructions for administering the training and include the end of unit tests and answers. The trainer may be the mine training officer or a senior hoist operator.

Part I will be modularized. In the description of the hoist machinery, for example, the trainee will know that there are drum hoists and friction hoists. If his hoist(s) is(are) drum hoist(s) he will use the module that contains a detailed description of a drum hoist but will not use the module that describes the details of the friction hoist(s).

There will be a short session on basic electric motor operation in Part I. Its purpose is to make the trainee aware of how the motor performs its job and the consequences of misuse. Also, since the State of Illinois requires that hoist operators be knowledgeable in electricity (the state mine hoist operator qualification examination has problems on Ohm's Law) there will be a module covering that subject. The latter module will be used only by those trainees who will have a need to know the contents therein—a hoist operator trainee in the State of Illinois, for example.

Part I will be structured in a self-study format. It may be adapted to a classroom setting, with lectures and demonstrations, should there be a sufficient number of trainees to justify the more formal approach.

Part II will be conducted in an "on-the-job" setting. The trainer (hoist operator) will require the trainee to know the specific features of the hoist(s) that he is being trained to operate. Based on the knowledge acquired in Part I, the trainee will be required to identify the specific features of the components that are in his hoist. He will then be required to learn the details of those components in sufficient depth to enable him to operate the hoist safely and effectively. His progress will be monitored by the hoist operator responsible for conducting the training. The instructional material for Part II will include descriptions in the form of sketches, text, or check lists and tests for use of the trainee. Administering instructions including answers to test questions will be provided for the trainer.

In Part III the trainee will be required to carry out the responsibilities of operating the mine hoist under the close tutelege of an experienced operator. He will be required to carry out the pre-shift operations, check the lubrication, lower and hoist the conveyance with men, materials, and ore, carry out emergency procedures and secure the hoist at the end of the shift to the satisfaction of the trainer. The instructional materials for Part III will include the tasks that the trainee is to perform and a set of standards for each task. Some of these standards may vary depending upon the mine's organization and/or state and local regulations.

It should be noted that, in some mine organizations, the hoist operator may not be responsible for lubrication of the hoist and/or other maintenance and inspection tasks.

In these mines the trainee will not be required to perform these tasks. The training materials for these tasks, however, may be used to train the maintenance or other personnel who will perform those tasks.

PART I: GENERAL DESCRIPTION OF HOIST

The hoist may function either as a service hoist (to lower/hoist men and materials into/from the mine) or a production hoist (to remove ore and waste products from the mine).

A. Structural Components of Hoist

This portion of the General Description will describe the following structural components of the hoist:

1. conveyance
2. head frames and sheaves
3. shafts
4. electrical system (control devices, motors, wires)
5. brakes
6. clutch
7. hydraulic system
8. fault boards and other indicators
9. communication system
10. wire rope

For each of the above components, the following descriptions will be provided:

- function of the component
- its structural features
- maintenance requirements
- inspection requirements
- standards—federal, state, local, or others

B. General Hoist Operations

In this portion of the General Description the following hoist operations will be described:

1. Prepare for shift operations
   a. lubricate hoist
   b. operate hoist full length of shaft and test safety devices
2. Moving the conveyance from one level to another

3. Lower men and materials into mine
4. Hoist ore/waste from mine
5. Place hoist in release state at end of shift
6. Logging procedures
7. Evacuation procedures
   - Ventilation failure
   - Fire
   - Pump failure
   - Other
   - Hoist Operator's Role
8. Emergency procedures
   - Charging air systems
   - Restoring lost power
   - Overtravel
   - Overspeed

TOPICAL OUTLINE FOR PART I: GENERAL DESCRIPTION OF A HOIST

A. Structural Components of Hoist

(1) Conveyance

Learning Algorithm: Recalling Bodies of Knowledge

Function
- Uses of skips/cages—carry materials/men
- Combinations in use—cage and skip, skip/cage and counterweight

Structural Components
- Frame work
- Rope attachments—sockets, u-clips, wedges
- Safety dogs
- Guide rails
- Dump gates
- Protective enclosure
- Tail ropes

Maintenance

Lubrication requirements, including:
- Dump gates
- Safety dogs
- Operating mechanisms

Inspection
- Testing of safety dogs
- Rope
  - Periodic reattachment
- Operational test of mechanical features
- Overhaul of operating parts
- Frequency

Standards
- Men and materials riding same conveyance
- Locking of dump gates when men are carried
- Side and overhead protection on cages

(2) Head Frames and Sheaves

Learning Algorithm: Recalling Bodies of Knowledge

Function
- Supports the sheave(s) or koepe wheel which in turn supports the hoist rope(s) and conveyance

Structural Components
- Head frame
- Head sheaves/koepe wheel
- Wheel diameter and relationship to wire diameter
- Bearings and shafts
- Slack rope cut off

Maintenance
- Lubrication
  - Sheave bearings
  - Wire rope

Inspection
- Wear on head sheave
- Testing slack rope cut off
- Frequency

Standards
- Height of headframes specifications
- Size of fleet angle
- Location and structure of platforms
- Diameter of sheaves

(3) Shafts

Learning Algorithm: Recalling Bodies of Knowledge

Function
- Provide paths for cages, skips, counterweights, utilities

Structural Components
- Types of shafts/number of conveyances
  - Single
  - Double
    - 2 skips/cages
    - skip/cage and counterweight
- Shaft guides
  - Composition
    - wood
    - steel
- Shaft lining
- Landing gates and platforms

Maintenance

Lubrication of landing gate mechanisms and shaft guides
Shaft guide upkeep

Inspection

Frayed/damaged electrical insulation
Condition of shaft guides
Housekeeping
Frequency

Standards

Safety gates
Shaft guides
Dumping facility construction
Means of passage around landing

(4) Electrical System

Learning Algorithm: Recalling Bodies of Knowledge

Function

Provide power to operate the hoist and its components

Background

Basic principles of electricity

Components/Features

Hoist motors

- Single
- Multiple
- Direct current
  - — SCR rectifier
  - — Motor generator set
- Alternating current
  - — Dynamic braking
    - Plugging - reversing
    - D.C. stator excitation
- Drive method
  - — Direct
  - — Geared
- Control devices
  - — Limit switches
  - — Slack cable switch
  - — Lilly control
  - — Motor control
  - — Deadman switch
  - — By-pass switch

Other Motors

- Hydraulic pump motor
- Air compressor motor
  - — Starting devices
- Meters/instruments
  - — Ammeters
  - — Voltmeters
  - — Indicator lights
  - — Fault boards

Power Cables
- Insulation
- Connections

Distribution Boards
- Maintenance power switch
- Indicator lights

Maintenance

Housekeeping
- Cleanliness vital
- No combustible trash
- Oil, dirt, water must be removed

Cable insulation and connections must be secure
Lubrication of bearings, operating joints

Inspection

Lubrication
Oil, dust, dirt, moisture in motors/generators
Bare wires or exposed live parts
Housekeeping
Loose connections
Grounding of metal non-current carrying parts

Standards

The standards in CFR 57.12 and in CFR 75 Subparts F, G, H, I, J, and K that apply to hoists will be covered

(5) Brakes

Learning Algorithm: Recalling Bodies of Knowledge

Function

Control speed of conveyances
Hold conveyances in position

Structural Components

Types of brakes:
- Disc
- Drum
  - Jaw
  - Parallel motion

Components of each type
- Disc/drum
- Pads/shoes
- Operating mechanisms

Operating mediums for braking
- Hydraulic/pneumatic
- Manual
- Gravity

Maintenance

Replacement of brake shoes, disc pads
Lubrication of working parts
Adjustment of operating mechanisms

Inspection

Requirements for inspection

- Shoes
- Linkages
- Operating mechanisms

Standards

Capacity of brakes

Automatic brake devices for power failures

Types of drums

(6) Clutch

Learning Algorithm: Recalling Bodies of Knowledge

Function

Engages/disengages hoist drum(s) from drive shaft

Structural Components

Types of clutch

- Friction
- Jaw

Functional aspects of:

- Single clutch
- Double clutch

Operating mediums

- Hydraulic
- Pneumatic
- Manual

Maintenance

Replacement of worn parts

Lubrication

Standards

Interlocking mechanism to hold drum by brake or secure to drive motor

(7) Hydraulic System

Learning Algorithm: Recalling Bodies of Knowledge

Function

Operate brakes, clutches, and other systems

Structural Components

Accumulator

- Pressure maintained by:
  - Compressed air
  - Gravity

Pump

Operating valves

Maintenance
- Lubrication
- Tightening connections
- Repairing valves
- Eliminating leaks
- Pump repairs

Inspection
- Inspection for leaks (oil, air)

Standards
- Devices to apply brakes automatically during power failures
- Regulations for inspection

(8) Fault Boards and Other Indicators

Learning Algorithm: Recalling Bodies of Knowledge

Function
- Indicate conditions
  - Concerning the hoist
  - Concerning other equipment in the mine

Structural Component
- Sensors
  - List typical conditions being monitored
  - Action taken by hoist operator for typical conditions

Maintenance
- Housekeeping—keep generally clean, free of oil/moisture
- Replacement of sensors/indicators

Inspection
- Testing the action of sensors/indicators
- Insulation of wiring

Standards
- Federal, state and local regulations

(9) Communication Systems

Learning Algorithm: Recalling Bodies of Knowledge

Function
- Provide communication channels

Components
- Types of communication system:
  - Bell system and bell code
  - Telephone
  - P.A. systems
  - Others
- Locations of communication outlets
- Communication procedures

Maintenance
- Housekeeping
- Corrective maintenance

Inspection

Checking of components of system to assure they are operating normally

Standards

Number of available methods of signalling between shaft stations and hoist room

Circumstances for telephone instructions

Adoption and posting of standard code for hoist signals

Location of signal devices

(10) Wire Rope

Learning Algorithm: Recalling Bodies of Knowledge

Function

Supports conveyance

Structural Components

Description and care of wire rope

Description of wire rope fittings

Maintenance

Lubrication of wire rope

Periodic refastening

Inspection

"Critical" areas - where indications of damage are more likely to be found

Abnormalities in wire rope, including:

- Reduction in rope diameter
- Stretching of the rope
- Worn, broken or corroded wires
- Indications of mechanical abuse
- Abrasions

Standards

Composition and diameter size

Safety factor

Cutting, seizing, splicing

Maintenance

- Inspection and removal
- Lubrication

Fastening methods

Periodic refastening

B. General Hoist Operations

(1) Prepare for Shift Operations

a. Hoist Lubrication

Learning Algorithms: Recalling Bodies of Knowledge
Detecting (determining if lubrication is needed)
Recalling Procedures and Positioning Movement (lubrication routine)

Function

Provide lubricants to those points that require it

Lubrication Systems

Oil flow system

- The oil flow system provides for a steady stream of oil to joints which are lubricated by oil

Oil reservoir system

- In the oil reservoir system a supply of oil is contained at the point to be lubricated

Equipment for determining if there is sufficient oil

Dipstick
Sight glass
Sight hole

Greasing System

The greasing system may be:

- An automatic, built-in system, which automatically greases certain points as the machine is operating
- A built-in system which must be operated manually, or
- A portable grease gun, with which the hoist operator or oiler periodically applies lubricants to those parts that need it

Lubrication Routine

Check to determine if points are in need of greasing—include wire rope
Apply grease as necessary
Check to determine if oil flow is sufficient and/or reservoirs are filled—replenish as necessary
Operate greasing mechanisms
Enter results in log book

b. Operate Hoist Full Length of Shaft and Test Safety Devices in order to ascertain that hoist is operating properly before beginning each shift.

Learning Algorithms: Recalling Bodies of Knowledge
Detecting (for inspection)
Recalling Procedures and Positioning Movement (testing of safety features, operating the hoist)

Procedure

Visually check

- Wiring for loose connections, damaged insulation
- Hoist housing, structure and drum for loose bolts, cracks, similar defects
- Brake mechanism—loose/worn shoes, mechanical defects, hydraulic pressure
- Safety cable—lubrication, broken wires, deformation

Operate hoist full length of shaft (see "moving the conveyance" for details) to make sure that

- Shaft is clear and will accommodate skip/cage
- Appearance and sound of running hoist is normal
- Wire rope has no apparent defects
- Depth indicator, ammeter, rope speed meter, and other indicators are functioning properly
- Brakes, clutches, other components are normal

Test the following:

- Communication systems
- Overspeed controls
- Overwind controls
- Overtravel by-pass switch
- Safety dogs
- Slack rope cut-off

(2) Moving the conveyance from one level to another

Learning Algorithm: Recalling Procedure and Positioning Movement

Procedure

Moving the conveyance manually

- Receive signal to lower conveyance to a specific level
- Acknowledge signal
- Close deadman switch
- Move motor controller slowly in the proper direction from the neutral position.
- Note ammeter; when needle deflects the proper amount, slowly release brake
- Continue to move the motor controller keeping the ammeter deflection within proper limits until rope speed is at cruising speed (the maximum allowed for the specific load). Use rope speed meter or sound/appearance of the hoist to estimate rope speed.
- Use a combination of motor control, dynamic braking, or hand braking to maintain cruising speed
- Note depth indicator; as conveyance nears point to start deceleration slow conveyance by reducing power, dynamic braking, hand braking
- Slow to creep speed as conveyance nears destination; note markings on drum as well as depth indicator
- At signal from destination set brake and put controller in neutral position, open deadman switch

Moving the conveyance automatically

- Move the conveyance manually to the desired level
- Notify cage/skip tender that hoist is in AUTOMATIC
- Put the selector switch on "AUTOMATIC"
- Monitor operation; note ammeter, rope speed meter, fault board

(3) Lower Men and Materials into Mine

Learning Algorithm: Recalling Procedure and Positioning Movement

Procedure

Operation of hoist manually

- Respond to signal
- If hoist is equipped with a clutch and 2 skips/cages, use clutch to adjust relative positions of skips/cages
- Bring cage/skip to loading level
- When hoist is loaded follow procedures for Moving the Conveyance from One Level to Another.

Operation of hoist automatically

- Switch hoist to automatic operation
- Release hoist to cage/skip tender in accordance with company policy
- Observe indicators to detect malfunctions

(4) Hoisting Ore/Waste From Mine

Learning Algorithm: Recalling Procedure and Positioning Movement

Procedure

Manual Hoist

- Following the procedure for Moving the Conveyance from One Level to Another, position one skip at the dump point and the other at the loading level
- Signal to start loading the skip
- When loaded hoist the skip to the dump point, lower the empty skip to the loading level
- Dump the loaded skip while the other is loading
- Repeat the process until completed

Automatic Hoist

- Position the skips at the loading and dump levels
- On signal from the loader put the hoist in automatic operation
- Observe indicators to detect malfunctions

(5) Place Hoist in Release State at End of Shift

Learning Algorithms: Recalling Procedure and Positioning Movement

Procedure

Move the cages/skips to mid-shaft position, clear of the landing level
Secure the cages/skips (i.e., set power control to neutral, set brake, check that cages/skips balance)
Disconnect the power
Enter general hoist condition and any problems encountered into the Log Book

(6) Logging Procedures

Learning Algorithms: Recalling Bodies of Knowledge (requirements for logging)
Recalling Procedures and Positioning, Movement

Function

Provide an accurate record of the general hoist conditions, the problems encountered by the hoist operators, and the remedial actions taken

Description

Examples of typical entries and their purposes

Standards

Requirements for complete and accurate records of:

- Installation
- Lubrication
- Inspection
- Tests
- Maintenance of shafts and hoisting equipment

(7) Evacuation Procedures

Learning Algorithm: Recalling Bodies of Knowledge

Procedure

Procedure for evacuation and the possible reasons for evacuation:

- Ventilation failure—safety regulations prescribed in the event of a main fan failure, include:
  - withdrawing all personnel
  - de-energizing power in affected area
  - prohibiting entry of unauthorized personnel into area
- Fire—procedure for evacuating in case of fire and safety regulations for fire prevention, including:
  - establishing no smoking programs
  - restricting use of open flames in mine
  - atmospheric requirements for welding and cutting
- Pump failure
- Other conditions

The role of the mine hoist operator in:

- Keeping the hoist manned and ready
- Use of the self-contained breathing unit
- Assisting in the evacuation of personnel
- De-energizing of the power
- Restricting unauthorized entry into the mine

(8) Emergency Procedures

Learning Algorithms: Recalling Bodies of Knowledge (reasons for low air pressure)
Detecting (determining when pressure is low)
Recalling Procedures and Positioning Movement

Low Air Pressure on Braking System

Reasons for low air pressure
Determining when air pressure is low
Function of the mine hoist operator:

- Stopping of hydraulic pump
- Bleeding air from reservoir
- Connect compressor to air reservoir
- Start compressor and charge the air reservoir
- When pressure is back to normal stop compressor and disconnect
- Restart the hydraulic pump

Restoring lost power

Put hoist control in neutral; set brake
Note that other machinery (hydraulic pump, air compressor, etc.) is switched off
Restore power
Restart other machinery

Overtravel (top and bottom)

Engage back-off switch
Move cage (using controller) to within operating area
Disengage back-off switch

Overspeed

When LILLY cuts off power:

- Put controller in neutral
- Set brake
- Reset "Power On" switch

PART II: SPECIFIC DETAILS OF HOIST

The variations of specific details in the hoist compcnents affect the procedures which the hoist operator must follow in carrying out his duties. The purpose of Part II of the training program is to provide the trainee with a detailed knowledge of the specific components of the hoist that he is being taught to operate.

He will acquire the detailed knowledge of his hoist through an examination of the equipment. He will supplement this knowledge and learn the effects of the variations on his duties through textual materials and discussions with the trainer. For some of the simpler pieces of equipment (e.g., the communication systems), the trainee will learn the details of the operating procedures concurrent with "hands on" use of the equipment.

Topical Outline for Part II

(1) Conveyance

Learning Algorithm: Recalling Bodies of Knowledge

Skip

Dump gates
Locking devices when carrying men

Cages

Enclosure

- Overhead
- Side

Rope Attachments

Socket
U-clips
Wedges
Tailropes

Safety Dogs

Coiled spring
Leaf spring
Other

(2) Head Frames

Learning Algorithm: Recalling Bodies of Knowledge

Head Sheaves

Koepe Wheel

Lubrication Points

Slack Rope Switch

(3) Shafts

Learning Algorithm: Recalling Bodies of Knowledge

Types of Shafts/Number of Conveyances

- Single
- Double
  - 2 skips
  - skip and cage
  - skip/cage and counterweight

Shaft Guides

- Wood
  - Need for frequent inspection
- Steel
  - Lubrication requirements

(4) Electrical System

Learning Algorithm: Recalling Bodies of Knowledge

Hoist Motors

- Single
- Multiple

Direct Current

- SCR rectifier
- Motor generator set

Alternating Current

- Plugging braking
- Reverse braking
- Dynamic braking
- D.C. Stator Excitation

Drive Method

- Direct
- Geared

Control Devices

- Lilly control
- Motor controller
- Dynamic brake

Other Motors

- Hydraulic pump motor
- Air compressor motor
  - Starting device

Fault Boards and Distribution Boards

- Indicator lights

(5) Brakes

Learning Algorithm: Recalling Bodies of Knowledge

Power

Manual

Disc
- Pads

Drum
- Jaw
- Parallel Motion
- Shoes

(6) Drums/Clutch

Learning Algorithm: Recalling Bodies of Knowledge

Single Drum
- Single rope
- Double rope
  - two conveyance
  - single conveyance and counterweight

Double Drum
- No clutch
- Single clutch
- Double clutch

Types of Clutch
- Friction
- Jaw

(7) Hydraulic System

Learning Algorithm: Recalling Bodies of Knowledge

Accumulator

Pressure maintained by:
- Compressed air
- Gravity

Pump
- Pump repair

(8) Communication Systems

Learning Algorithms: Recalling Bodies of Knowledge
Recalling Procedures and Positioning Movement

Bell System

Bell Code

Telephone

PA System

Others

Location of communication outlets

Location of signal devices

Location of posted code for hoist signals

Standard communication procedures specific to mine

(9) Wire Rope

Learning Algorithm: Recalling Bodies of Knowledge

Construction

Core
- Fiber
- Independent wire rope (IWRC)
- Wire strand

Number of wires in a strand
- Coarse laid: 4 to 8
- Standard and Extra Flexible: 16-25 (usually 19)
- Special Flexible: 19+ (usually 37)
- Arrangement of Strands

Lay
- Regular Lay
  - Right
  - Left
- Lang Lay
  - Right
  - Left

Diameter

Normal appearance of wire rope

(10) Lubrication

Learning Algorithms: Detecting (for locating leaks, identifying parts in need of oil/grease)
Recalling Procedures and Positioning Movement

Identify parts to be greased

How each point is greased
- Automatic
- Built-in manual
- Portable grease gun

Type of grease used for each part
- Location of supply

Identify parts that require oil

Types of oil systems
- Reservoir system
- Oil flow through system
  - Pump
  - Gravity

Method of checking oil level
- Dipstick
- Sight glass
- Sight hole

Type of oil needed for each part
- Location of supply

(11) Safety Devices and Instruments

Learning Algorithms: Recalling Bodies of Knowledge
Recalling Procedures and Positioning Movement (for operating devices)

Instruments
- Ammeter
- Volt meter
- Rope speed meter
- Oil gauge
- Air pressure gauge

Safety Devices
- Limit switches
- Slack cable switch
- Deadman switch
- Safety dogs
- Overspeed controls
- Overwind controls
- Overtravel by-pass switch
- Slack rope cut-off

PART III: "HANDS ON" OPERATION OF EQUIPMENT

In Part III of the training program, the trainee will develop the skills necessary for operating a hoist. Under the supervision of the trainer, the trainee will perform the following hoist operations:

Pre-Shift Activities

Lubrication

Hoisting and Lowering of Men, Materials, and Ore Into/Out of the Mine

End of Shift Activities

Emergency Procedures

Topical Outline for Part III

(1) Pre-shift Activities

Learning Algorithms: Detecting (for inspection)
Recalling Procedures and Positioning Movement
Guiding and Steering Continuous Movement (for operating the hoist)

Visual Examination of:
- Wiring
- Hoist housing drum and structure
- Brake mechanism
- Safety cable
- Cage, platform, elevators, etc.
- Landing gates or doors

Operate the hoist full length of shaft to check:
- Ammeter, depth indicator, rope speed meter, and all other indicators
- Appearance and sound of running hoist
- Wire rope
- Shaft
- Brakes, clutches, other components

Test the following devices:
- Communication system
- Overspeed controls
- Overwind controls
- Overtravel by-pass switch
- Safety dogs
- Slack rope cut-off
- Automatic stop controls

Ride top of cage or elevator to check:
- Guide buntons
- Power wires
- Other features

(2) Lubrication

Learning Algorithms: Detecting (points in need of lubrication)
Recalling Procedures and Positioning Movement
Guiding and Steering, Continuous Movement (loading gun, lubricating)

Examine all parts of hoist which require greasing or oiling
Determine which parts are in need of lubrication (i.e., visually, with dipstick, sight glass or sight hole)
Locate the proper grease or oil
Load portable grease gun (if applicable)
Lubricate parts of hoist which need oil or grease

(3) Hoisting/Lowering of Men, Materials and Ore

Learning Algorithms: Recalling Procedures and Positioning Movement
Guiding and Steering, Continuous Movement

Operate the hoist as a service hoist:

Hoisting/lowering

- Start
- Stop
- Creep
- Accelerate
- Decelerate
- Cruise

Operate the hoist as a production hoist:

Hoisting/lowering
Dumping/loading

Operate both manually and automatically (if applicable)

(4) End of Shift Activities

Learning Algorithms: Recalling Procedures and Positioning Movement
Guiding and Steering, Continuous Movement (for moving the cage/skip)

Move cage/skip to midshaft position

Secure the cage/skip

Disconnect power

Enter relevant information into Log Book

(5) Emergency Procedures

Learning Algorithms: Recalling Procedure and Positioning Movement
Guiding and Steering, Continuous Movement (for charging air systems)

Demonstrate ability to handle emergencies to include but not be limited to:

Evacuation procedures

- Ventilation failure
- Fire
- Pump failure
- Other conditions
- Use of emergency breathing sets

Charge air systems
Restore lost power
Overspeed power cut off
Overtravel power cut off
Slack rope power cut off

TASK VI: PERFORM TRADE-OFF STUDIES

As stated in the Introduction, the present method of training hoist operators accomplishes the desired objectives. We believe, however, that the training can be improved from the standpoint of thoroughness and cost effectivenss.

Under the present system the trainee spends from 2 weeks to 3 or 4 months in on-the-job training. The average estimate was that training lasts approximately 8 weeks. A trainee who has progressed from skip or cage tender to hoist oiler or another similar hoist maintenance job will be quite familiar with the hoist and its operation. He will require a shorter time for on-the-job training. Those trainees who have had no previous experience associated with the hoist will take longer periods to train.

Although a mine operator would prefer that all hoist operator trainees had previously gone through the skip/cage tender, hoist maintenance steps, this is not always possible. Job seniority and other factors limit freedom of choice in selecting the trainees.

The average rate of straight time pay, including fringe benefits for the trainee, is about $450 per week. The trainees' pay and fringe benefits during the training period, then is approximately $3,600.

We believe that Parts I and II of the training system will provide the trainee with the informational background he would have acquired on-the-job as a skip tender and maintenance man. We also believe that if the trainee has the aptitude to be a hoist operator, he can complete Parts I and II in two weeks or less. A trainee who uses the proposed training system will take no more than 4 weeks to complete the course, two weeks on Parts I and II and two weeks on Part III. This will halve the training time of the present method.

An additional savings will occur when those trainees who do not exhibit an aptitude for hoist operation during Parts I or II of the training system are eliminated from the program.

Another factor which must be considered in the trade-off studies is the cost of specific instructional methods to be employed during Part I. As stated earlier, Part I is expected to take one week of time. By using the self-study method, the instructor time can be largely eliminated. The actual time spent on monitoring the trainee's progress and administering tests is expected to be no more than 4 hours for one trainee. To

match the 1/2 instructor pay per trainee cost of the self-study method, ten trainees would have to be trained at one time using the classroom lecture/visual aid method of instruction.

From our observations during the mine site visits, we have determined that the need to train more than one or two hoist operators at one time at any one mine location would be unlikely.

Our conclusion then is that the proposed strategy developed in the previous task, with Part I conducted as a self-study program, will be a cost effective method of accomplishing this part of the training of mine hoist operators.

The actual format of the self-study materials for Part I has not been clearly identified at this writing. As stated in the discussion of Instructional Strategies in Task V, the candidate materials are:

- Microfiche with self-scoring tests
- Programmed Text—branching with self-scoring
- Independent study using textbooks, handbooks, tests and workbooks.
- Programmed text—linear with instructor scored criterion tests.

The microfiche with self-scoring tests does not appear to be practicable at most mine sites as a microfiche reader is not likely to be available.

Since (as stated in Task II) there are no texts specifically suited to training mine hoist operators, any textual materials to be used in the training program must be developed. Since we will modularize the training system to cover all the variations in both existing and new hoists, the "texts" will most likely appear in the form of a workbook, probably loose-leaf. The major portion of the material will appear in a format suitable both for self-study and for classroom training. Criterion tests will be provided, to be administered and scored by an instructor/monitor. A certificate noting successful completion of the training system will be provided for presentation to the successful trainees.

TASK VII: PREPARE THE PHASE I REPORT

Task VII calls for a Phase I Report to be prepared upon completion of Tasks I through VI. The Phase I Report contains a discussion of our activities and conclusions in Phase I of the Project, and provides a brief explanation for our rationale.

In Phase II, the project team will develop and validate the training system for Mine Hoist Operators. In our original proposal we included a tentative plan for completing Phase II, and made minor revisions to the plan in our "Best and Final" offer submitted prior to contract award. We also stated that the plan would be revised and updated and included in the Phase I Report. Having completed Phase I, we feel that the Plan for Phase II which appeared in our "Best and Final" offer is still satisfactory, and can be followed without alterations. Hence, no changes in the original time schedule and cost estimates are foreseen. The Phase II Plan appears on the following pages.

The five sites for validating the training system will be selected in the early stages of Phase II. We will need to contact several mines, find out which ones will need to train one or more hoist operators in the next 5-6 months, and select accordingly. Our selection will be submitted to the Project Officer for approval.

PROGRAM PLAN—PHASE II

Task	Exhibit A No.	Name/Title Assigned Personnel	Man-Hours	Time Spent	Travel	Task Product
Select Field Sites and Plan Phase II	3.2.1	P. Loustaunau Project Director	80	1st to 3rd Week		The complete program plan for Phase II will be prepared and approved. Site selection, number of trainees, and number and length of instructional periods will be determined.
		R. Rosenblatt Educational Specialist	40			
		J. Kelly Mining Specialist (Consultant)	16			
		Technical Writer Editor	8			
		Research Associate	8			
		J. Pumphrey Secretary	20			
Development of Training System	3.2.2	P. Loustaunau Project Director	280	4th-16th Week		The training system, including text material, visual aids and evaluative instruments will be completed in draft form.
		R. Rosenblatt Educational Specialist	240			
		Technical Writer Editor	160			
		J. Kelly Mining Specialist (Consultant)	64			
		Research Associate	140			
		J. Pumphrey Secretary	120			
Prepare and Deliver 1st Monthly Phase II Report	–	P. Loustaunau Project Director	8	5th Week	P. Loustaunau to Pittsburgh—1 day	The 1st monthly report for Phase II will be delivered to the Contracting Officer.
		J. Pumphrey Secretary	4			

(Continued)

Task	Exhibit A No.	Name/Title Assigned Personnel	Man-Hours	Time Spent	Travel	Task Product
Prepare and Deliver 2nd Monthly Report for Phase II	–	P. Loustaunau Project Director	8	9th Week	P. Loustaunau to Pittsburgh—1 day	The 2nd monthly report for Phase II will be delivered to the Contracting Officer.
		J. Pumphrey Secretary	4			
Prepare and Deliver 3rd Monthly Report	–	P. Loustaunau Project Director	8	13th Week	P. Loustaunau to Pittsburgh—1 day	The 3rd monthly report for Phase II will be delivered to the Contracting Officer.
		J. Pumphrey Secretary	4			
Prepare and Deliver 4th Monthly Report	–	P. Loustaunau Project Director	8	18th Week	P. Loustaunau to Pittsburgh—1 day	The 4th monthly report for Phase II will be delivered to the Contracting Officer.
		J. Pumphrey Secretary	4			
Review and Revision of Text For Technical Accuracy	–	P. Loustaunau Project Director	104	17th-21st Week		The instructional material will be technically accurate.
		R. Rosenblatt Educational Specialist	40			
		Technical Writer Editor	20			
		J. Kelley Mining Specialist (Consultant)	40			
		J. Pumphrey Secretary	40			
Review and Revision of Text For Suitability of Instructional Techniques		P. Loustaunau Project Director	48	22nd-24th Week		The instructional techniques used will be suited to the training system.
		R.C. Trexler	40			
		R.J. Seidel	40			
		H. Wagner HumRRO Program Directors	40			
		R. Rosenblatt	40			
		Technical Writer/Editor	20			
		J. Pumphrey Secretary	32			

(Continued)

Task	Exhibit A No.	Name/Title Assigned Personnel	Man-Hours	Time Spent	Travel	Task Product
Prepare and Deliver 5th Monthly Report	–	P. Loustaunau Project Director	8	22nd Week	P. Loustaunau to Pittsburgh–1 day	The 5th monthly report for Phase II will be delivered to the Contracting Officer.
		J. Pumphrey Secretary	4			
Validation of Training System at 1st Site	3.2.3	P. Loustaunau Project Director	72	25th-27th Week	P. Loustaunau and R. Rosenblatt to Beckley, West Virginia–5 days J. Kelly–2 days	The course will have been validated at the first site.
		R. Rosenblatt Educational Specialist	72			
		J. Kelly Mining Specialist (Consultant)	16			
		Research Associate	8			
		J. Pumphrey Secretary	8			
Prepare and Deliver 6th Monthly Report		P. Loustaunau Project Director	8	27th Week	P. Loustaunau to Pittsburgh–1 day	The 6th monthly report for Phase II will be delivered to the Contracting Officer.
		J. Pumphrey Secretary	4			
Validation of Training System at 2nd Site	3.2.3	P. Loustaunau Project Director	60	28th-30th Week	P. Loustaunau and R. Rosenblatt to Clarence Center, N.Y.–5 days J. Kelly–2 days	The course will have been validated at the second site.
		R. Rosenblatt Educational Specialist	60			
		J. Kelly Mining Specialist (Consultant)	16			
		Research Associate	8			
		J. Pumphrey Secretary	16			

(Continued)

Task	Exhibit A No.	Name/Title Assigned Personnel	Man-Hours	Time Spent	Travel	Task Product
Prepare and Deliver 7th Monthly Report	–	P. Loustaunau Project Director	8	31st Week	P. Loustaunau to Pittsburgh–1 day	The 7th monthly report for Phase II will be delivered to the Contracting Officer.
		J. Pumphrey Secretary	4			
Validation at 3rd Site	3.2.3	P. Loustaunau Project Director	20	31st-33rd Week	R. Rosenblatt to Sunnyside, Utah–5 days J. Kelly–2 days	The validation at the 3rd site will have been completed.
		R. Rosenblatt Educational Specialist	60			
		J. Kelly Mining Specialist (Consultant)	16			
		Research Associate	8			
		J. Pumphrey Secretary	16			
Validation at 4th Site	3.2.3	P. Loustaunau Project Director	60	34th-36th Week	P. Loustaunau to Norton, Va.–5 days J. Kelly–2 days	The validation at the 4th site will have been completed.
		J. Kelly Mining Specialist (Consultant)	16			
		Research Associate	8			
		J. Pumphrey Secretary	16			
Prepare and Deliver 8th Monthly Report		P. Loustaunau Project Director	8	34th Week	P. Loustaunau to Pittsburgh–1 day	The 8th monthly report for Phase II will be delivered to the Contracting Officer.
		J. Pumphrey Secretary	4			

(Continued)

Task	Exhibit A No.	Name/Title Assigned Personnel	Man-Hours	Time Spent	Travel	Task Product
Validation at 5th Site	3.2.3	P. Loustaunau Project Director	6	37th-39th Week	R. Rosenblatt to Ducktown, Ga.–5 days J. Kelly–2 days	Validation at the 5th site will have been completed.
		R. Rosenblatt Educational Specialist	40			
		J. Kelly Mining Specialist (Consultant)	16			
		Research Associate	8			
		J. Pumphrey Secretary	24			
Prepare and Deliver 9th Monthly Report		P. Loustaunau Project Director	8	40th Week	P. Loustaunau to Pittsburgh–1 day	The 9th monthly report will have been delivered to the Contracting Officer.
		J. Pumphrey Secretary	4			
Prepare and Deliver Draft of Final Report	3.2.4	P. Loustaunau Project Director	300	40th-52nd Week		The final report will be prepared and delivered to the Contracting Officer.
		R. Rosenblatt Educational Specialist	300			
		Technical Writer Editor	40			
		J. Kelly Mining Specialist (Consultant)	24			
		Research Associate	40			
		J. Pumphrey Secretary	120			
Prepare and Deliver 10th Monthly Report	–	P. Loustaunau Project Director	8	44th Week	P. Loustaunau to Pittsburgh–1 day	The 10th monthly report will have been delivered to the Contracting Officer.
		J. Pumphrey Secretary	4			

(Continued)

Task	Exhibit A No.	Name/Title Assigned Personnel	Man-Hours	Time Spent	Travel	Task Product
Prepare and Deliver 11th Monthly Report	–	P. Loustaunau Project Director	8	48th Week	P. Loustaunau to Pittsburgh—1 day	The 11th monthly report will have been delivered to the Contracting Officer.
		J. Pumphrey Secretary	4			
Deliver the final report and make an oral briefing on the conduct of the Project to the Contracting Officer	3.2.4 3.2.5	P. Loustaunau Project Director	40	53rd Week	P. Loustaunau to Pittsburgh—1 day	All project deliverables will have been made.
		J. Pumphrey Secretary	8			

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HumRRO
Project SHAFT

RESPONDENT BACKGROUND INFORMATION FORM

ID # _____ Current Job: Operator [ ]
Inspector [ ]
Mechanic [ ]

HOISTING EXPERIENCE:

1. How long have you been working with mine hoists, including work you may have done as an operator, inspector, or mechanic?

(Probe for months as)

Operator: _____ months
Inspector: _____ months
Mechanic: _____ months

2. How long have you been working with this hoist?

(Probe for months as)

Operator: _____ months
Inspector: _____ months
Mechanic: _____ months

TRAINING:

3. Did you receive any training on how to operate, maintain, or inspect this hoist?

YES [ ]
NO [ ]

(Probe for OJT. Ask why no training was necessary)

4. How many months of on-the-job training did you have before you worked on this hoist alone? (Define OJT if necessary.)

_____ months

5. Besides your on-the-job training, did you receive any special training on:

- The signalling system used with this hoist?

  [ ] NO [ ] YES (Describe): _____

  _____

  _____

  _____ Length: _____

- The inspection of this hoist?

  [ ] NO [ ] YES (Describe): _____

  _____

  _____

  _____ Length: _____

- How to operate this hoist?

  [ ] NO [ ] YES (Describe): _____

  _____

  _____

  _____ Length: _____

- How to maintain this hoist?

  [ ] NO [ ] YES (Describe): _____

  _____

  _____

  _____ Length: _____

- Other (specify): _____

  [ ] NO [ ] YES (Describe): _____

  _____

  _____

  _____ Length: _____

6. Did you receive any training on the capacity of this hoist? For example:

   - How many men can it carry on one trip? _____
   - How many tons of material can it carry on one trip? _____
   - Were you told about the effects of sudden starts and stops on the hoist and wire ropes?

     [ ] NO [ ] YES (Describe): _____

     _____

     _____

BACKGROUND:

7. How old are you? _____ years

8. How much schooling did you complete?

   [ ] less than 8th grade

   [ ] some high school

   [ ] high school graduate

   [ ] some college

   [ ] college graduate _____ (Degree)

   [ ] technical school training

MINE PRODUCT: _____ DEPTH: _____ Ft.

SLOPE ☐ SHAFT ☐

TYPE HOIST: Koepe

- Single Wheel ☐
- Multi Wheel ☐ (___)
- Single Clutch ☐
- Double Clutch ☐
- Counter Weight ☐
- Double Conveyance ☐

DRUM

- Single ☐
- Multi ☐ (___)
- Grooved ☐
- Smooth ☐
- Single Clutch ☐
- Double Clutch ☐
- Counter Weight ☐
- Double Conveyance ☐

CONVEYANCES

- Skip ☐
- Cage ☐
- Skip and Cage ☐
- Elevator ☐

ROPES

- Single ☐
- Multi ☐ (___)

ROPE TYPE

- Round Strand ☐
- Flattened Strand ☐
- Locked Coil ☐

SHAFT GUIDES

- Wood ☐
- Steel Rails ☐
- Wire Rope:
  - Full Lock ☐
  - Half Lock ☐

BRAKES

- Drum:
  - Jaw ☐
  - Parallel Motion ☐
- Disc ☐

LEVELS

- Single ☐
- Multi ☐ (___)

DRIVE MOTORS (____)

- Alternating Current ☐
- Direct Current ☐
- SC Rectifier ☐
- Motor Generator ☐

Identification Code _____

HumRRO Project SHAFT Task Analysis Information Sheet

Mine_____ Shaft_____ Function_____ Respondent_____ Shift_____

ID #	Action (Behavior)	Objective (Purpose)	Tools/Equipment	Instructions	Standards	Frequency	Duration

TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE A+B - PRODUCTION/SERVICE
MULTI-LEVEL MINE; DOUBLE DRUM HOIST; DOUBLE CLUTCH; MANUAL
OPERATION: *A. Conduct an Operational Test of the Hoist.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Test Power Application	Assure that the hoist motor controller is operable.	
a) Move controller off neutral to hoist "slow."	Test controller in hoist position.	Controller operation.
b) Note deflection of Ammeter.		Ammeter location and permissible deflection.
c) Move controller back to neutral.		Controller operation.
d) If no deflection, call electrician.	Obtain assistance.	Electrician identify/location.
e) Move controller off neutral to lower "slow."	Test controller in lower position.	Controller operation.
f) Note deflection of Ammeter.		Ammeter location and permissible deflection.
g) Move controller back to neutral.		Controller operation.
h) If no deflection, call electrician.	Obtain assistance.	Electrician identify/location.
2. Run Hoist through entire length of travel.	Assure that hoist is operable.	
a) Check both clutches are engaged; if not, engage them.	Operate both skips/cages together.	Clutch operating handle location and function.
1) Move clutch operating control to engaged position--engage clutch.		

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
b) Send skip/cage nearest the lowest landing or collar to that position.	Raise/lower skip/cage.	
1) Move hoist controller to slow lower/hoist.	Apply power to hoist motor.	Controller operation.
2) Note Ammeter deflection.	Assure that power is applied to motor.	Ammeter location, permissible deflection.
3) As Ammeter deflects release brake, note rope speed meter.	Free skip/cage to move and note that it starts.	Brake control location/operation, rope speed meter operation, permissible rope speeds.
a) If rope does not move reset brake, put hoist control in neutral and call an electrician/mechanic.	Hoist malfunctional. Assistance is needed.	Identify/location of maintenance electrician/mechanic.
4) Ease hoist control to allowable high speed position.	Increase speed of hoist	Controller operation, depth indicator markings.
a) If Ammeter deflects too much, move controller more slowly.	Prevent overcurrent damage to motor.	Permissible ammeter deflection.
5) Note that rope speed does not exceed allowable limit. Use dynamic brake if necessary.	Prevent hoist from overspeeding.	Dynamic braking procedures, permissible rope speeds, depth indicator markings.
6) As depth indicator shows that skip/cage is nearing destination, ease control to slow position; use dynamic braking if necessary to assist deceleration.	Decelerate cage/skip to prevent sudden stop.	Procedures for slowing (dynamic braking), depth indicator marking, controller operation.

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
7) As depth indicator shows that skip/cage is at destination, move hoist control to neutral and apply brake.	Stop hoist.	Controller/brake operation, depth indicator markings.
3. Test Overtravel Limit Switch		
a) Move hoist control in same direction "slow" and release brake as soon as Ammeter deflects.	Move skip/cage past overtravel limit switch.	Controller/brake operation, depth indicator markings.
1) Power is shut off and brake applied shortly after skip/cage moves.	Overtravel limit switch functions.	Permissible distance beyond limit switch cut-out which skip/cage can travel.
a) If not--set brake, put hoist control in neutral and call a mechanic/ electrician.	Overtravel switch malfunctioned, obtain assistance.	Mechanic/electrician identification and location.
2) If overtravel limit switches function press limit switch by-pass button, put hoist control in "slow" reverse and release brake.	Skip/cage is brought back to the normal operating area.	Limit switch overtravel by-pass location and function, controller/ brake function.
3) Place hoist control in neutral and apply brake as cage/skip reaches the desired level.	Skip/cage is at its normal extreme of travel.	Controller/brake function, depth indicator markings.
b) Disengage clutch on skip/cage that is at the desired level.	Second cage/skip is ready to be moved to its normal extreme travel.	Clutch handle location and function.

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ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
c) Hoist/lower the second cage/skip to its original destination.	Move second cage/skip to its extreme position of travel.	
1) Move hoist control to "slow" in proper direction.	Start cage/skip.	Same as 2)b)1) through 7) above.
2) As Ammeter deflects, release brake, increase speed and proceed as in 2)b)3)4)5) above.	Accelerate cage/skip. Slow and stop cage/skip at desired level.	
d) Test overtravel limit switches as in 3.a) above.	Assure that overtravel limit switches operate properly.	Same as 3.a) above.
1) If limit switches function properly, press by-pass switch button and bring cage/skip back to its desired position.	Skip/cage is brought back to the normal operating area.	
e) Engage clutch.	Skips/cages are locked together.	Clutch handle function.
f) Run skips/cages in the opposite direction and test limit switches at the opposite extremes. Follow 2.b)1) through 7) above.	Determine if shafts are clear and overtravel limit switches at other travel extremes are functioning as they should.	Same as 2.b)1) through 7).
4. Test Overspeed Cut-out.	Assure that overspeed cut-out functions properly.	
a) Raise balls on LILLY control.		Location and function of LILLY Control.
1) Power should be shut off.	Normal function.	
2) If not, call electrician.	Obtain assistance.	Identify/locate maintenance personnel.

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
b) Restore power to hoist.	Return to normal.	Location and function of main power switch.
5. Test safety dogs and slack wire cut-out.	Assure that safety dogs and slack wire cut-out are operational.	
a) Block conveyance to prevent its being lowered.	Hold cage in place.	Type of conveyance blocks used and means for blocking them.
1) Use beams in the shaft, or such other devices as are available.		
2) Have mechanic watch the top of the conveyance.	Note action of safety dogs.	Correct operation of the safety dogs.
b) Move controller to lower conveyance a very short distance--2 to 3 feet. Return controller to neutral.	Remove tension from hoist rope.	Motor controller functions.
1) Power should cut off; if not call electrician.	Obtain assistance if slack wire switch fails.	Identity of maintenance personnel.
2) Safety dogs should begin to engage shaft guides.	Safety dogs are operational.	
c) Restore power.	Return to normal.	Location and function of power switch.

TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE A+B - PRODUCTION/SERVICE
MULTI-LEVEL MINE; DOUBLE DRUM HOIST; DOUBLE CLUTCH; MANUAL
OPERATION: *B. Lubrication*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Greasing.		
a) Automatic system.		
1) Inspects grease reservoir.	Assure a supply of grease.	Interval of inspection. Inspection access to reservoir. Level of grease in reservoir when "full."
a) If reservoir not full, replenish with proper grease.		Appearance or designation code or "proper" grease. Location of grease supply. Replenishment access to reservoir.
2) Test system.	Assure system operation.	Test procedure for Automatic system.
a) If test fails, call mechanic.	Obtain assistance.	Identification and location of mechanic.
3) Inspects lubrication points.		Location of lubrication points.
a) Observes presence or absence of fresh/sufficient grease.	Assure system is greased.	Appearance of sufficiently greased part.
b) Call mechanic if grease is absent.	Obtain assistance.	Identification and location of mechanic.
4) Make required log entries.	Record activities.	"Logging" procedure, if required.
b) Installed Manual System.		
1) Inspect grease reservoir.	Assure grease supply.	Interval of inspection. Level of grease in full reservoir.
a) If not full, replenish with proper grease.	Provide additional grease.	Location of grease supply.

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
2) Operate greasing system.	Apply grease.	System operation procedures.
3) Inspect lubrication points.	Assure proper functioning of system.	Location and proper appearance of points to be greased.
a) Observe presence/ absence of fresh/ sufficient grease.		
b) If grease absent, call mechanic.	Obtain assistance.	Identity and location of mechanic.
4) Make required log entries.	Record activities.	Logging requirements.
c) Portable grease guns.		
1) Inspect lubrication points.	Determine points needing grease.	Location of lubrication points.
a) Observe presence/ absence of fresh/ sufficient grease.		
b) If grease absent, continue with 2)3)4) below.		
2) Inspect grease gun content.	Assure supply of grease.	Appearance of full grease gun.
a) If not full, replenish with proper grease.		Location of grease gun and grease supply. Loading of grease gun.
3) Check operation of gun.	Assure gun operates properly.	Operation of grease gun.
a) If grease not excluded, call mechanic.	Obtain assistance.	Identity and location of mechanic

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ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
4) Operate grease gun at all lubrication points.	Apply grease.	Operation of grease gun.
a) If fresh grease does not emerge from fitting, call mechanic.	Obtain assistance.	Identity and location of mechanic.
5) Make required log entries.	Record activities.	Logging requirements.
2. Oiling		
a) Oil Flow System.		
1) Check level of oil in reservoir using dip-stick or sight glass as appropriate.	Assure sufficient oil supply.	Interval of reservoir inspection. Location of dipstick or sight glass. Level on dipstick or sight glass indicating full reservoir.
a) If oil level low, replenish with proper oil.		Location of "refill" port. Location of proper oil supply.
2) Check operation of pump, typically by inspecting pressure gauge.	Assure pump operating properly.	Location and normal appearance of pump and pressure reading.
a) If not correct, call mechanic.	Obtain assistance	Identification and location of mechanic.
3) Check system for leaks.		
a) If leak detected, call mechanic.	Obtain assistance.	Appearance of leak. Identification and location of mechanic.

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
4) Inspect sight glass at each bearing.	Assure oil flow through bearings.	Location of each sight glass.
a) If flow is abnormal call mechanic.	Obtain assistance.	Appearance of normal/abnormal flow. Identification and location of mechanic
5) Make required log entries.	Record activities.	Logging procedure.
b) Oil Reservoir System.		
1) Check level of oil in each reservior using dipstick or sight glass as appropriate.	Assure sufficient oil supply at each bearing.	Interval of inspection. Location of dipstick or sight glass.
a) If oil level is low, replenish with proper oil.	Correct lack of oil.	Location of oil supply. Type of oil used.
2) Observe each bearing for leaks.	Eliminate leaks.	Appearance of leaks.
a) If leak detected, call mechanic.	Obtain assistance.	Identification and location of mechanic.
3) Make required log entries.	Record activities.	Logging procedure.

TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE A + B - SERVICE
MULTI-LEVEL MINE; DOUBLE DRUM HOIST; DOUBLE CLUTCH; MANUAL
OPERATION: *C. Lower Men or Materials into the Mine.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Hoist operator hears signal to bring cage/skip to loading level to lower men/materials.	Operator is notified of what he has to do.	Communication system use and code.
2. Hoists nearest cage/skip to loading level.	To bring cage/skip to loading level.	
a) Moves controller to hoist "slow" position, notes Ammeter deflection, release brake.	Hoist is started.	Controller operation, location and deflection limits of Ammeter, brake operation.
b) Hoist starts to move, advance hoist controller to increase speed keeping Ammeter deflection within normal bounds and rope speed at acceptable level.	Hoist is accelerated to cruising speed.	Controller operation and sound of hoist operating normally, normal appearance of rope, allowable rope speeds, normal Ammeter readings, depth indicator marking.
c) As hoist approaches loading level bring controller to "slow" and decelerate; possibly use dynamic braking.	Hoist is decelerated.	Dynamic braking operation, start deceleration process, controller operation.
d) As cage/skip reaches loading level, receive signal to stop.	Hoist operator is notified that skip/cage is at desired level.	Communication system use and code, markings on depth indicator.
e) Place hoist control in neutral -- applies brake.	Hoist is stopped at desired level.	Controller and brake operation, markings on depth indicator.
3. While first skip/cage is loading receive signal to hoist men from a lower level.	A signal is received to bring hoist to another level--second cage/skip will be used.	Communication system use and code.

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
a) Disengage clutch on first skip/cage.	Disengage first skip/cage.	Clutch operating handle location and function.
b) Raise/lower second skip/cage to desired level--follows procedure in 2.a)through e) above.	Second skip/cage is brought to desired level.	Same as steps 2.a) through e)
4. Both skips/cages are loaded and signal is received to lower first one and raise second one.	Operator is notified that both skips/cages are ready to move to their destinations.	Communication system use and code.
a) Engages clutch on second skip/cage.	Second skip/cage clutch is engaged.	Clutch operating handle location and function.
b) Move hoist control to lower first skip/cage, note Ammeter deflection and release brake.	Both skips/cages move to their destinations.	Same as steps 2.a) through e)
c) Follow acceleration, cruise, deceleration, stop procedures in 2.a) through e) above.	The first skip is taken to its destination.	
1) Stop when either skip/cage reaches its destination.	The first skip is stopped at its destination.	
2) Disengage clutch on that cage/skip.		Clutch operating handle location and function.
3) Bring second skip/cage to its destination using 2.a) through e) procedure.	Both skips/cages are at their destinations.	Same as steps 2.a) through e) above.
5. When next signal is received, repeat the 1, through 4. procedure above.		

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TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE A+B - PRODUCTION
LEVEL MINE; DOUBLE DRUM HOIST; DOUBLE CLUTCH; MANUAL
OPERATION: *D. Take Ore/Muck Out of Mine*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Receives signal to hoist muck/ore from a specific level.	Hoist muck/ore from specific level of the mine.	Communication system use and code.
a) Hoist operator sends skip nearest the dump point to the dump point, stops the skip and sets the brake.	Align skips for production hoisting.	
Procedure is the same as in Mine A+B C. Lowering Men/ Materials into Mine, 2. a) through e).		Procedures and knowledges are the same as those indicated.
b) Disengage clutch from skip at dump point.		
c) Send other skip to loading level.		
Procedure is the same as in Mine A+B C. Lowering Men/ Materials into Mine, 3.a)b).		Procedures and knowledge are the same as those indicated.
d) Engage clutch.	Skips are aligned.	Clutch handle location and operation.
2. Notify skip tender at loading level to start loading.	One skip will be loaded.	Communication system use and code.
a) When skip is loaded receive signal to hoist.	The loaded skip is ready to be taken to the dump.	Communication system use and code.
b) Hoist loaded skip, lower empty skip as follows:	The loaded skip is taken to the dump.	
1) Move hoist control to slow hoist, release brake as Ammeter deflects, note rope moving.	The hoist is accelerated.	Controller/brake operation, Ammeter permissible deflection, permissible rope speed.

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ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
2) Advance hoist control keeping ammeter deflection within prescribed limits, until rope speed is at prescribed rate. Maintain this speed with hoist control.	The hoist reaches its cruising speed.	Dynamic braking procedures.
3) As loaded skip approaches dump point see indication on depth indicator--use hoist control to slow movement. Just prior to loaded skips reaching the dump point, shift attention to empty skip which is nearing load point.	The hoist is decelerated as skips reach their destinations.	Dynamic braking procedures, depth indicator markings, permissible Ammeter readings.
4) On receipt of "stop" signal from skip tender at loading level, stop skip and hold with hoist control.	The loaded skip is dumped while the other skip is loaded.	Communication system use and code. permissible Ammeter readings, controller operation, depth indicator markings.
5) On expiration of loading interval hoist loaded skip and lower empty skip—skip at dump should be unloaded by the time the other skip is loaded. Use procedure b) 1) through 5) above. Be alert	The process in 1. and 2. is repeated.	Communication system use and code, time required to load/unload.

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ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
for a "Hold" signal from skip tender at dump in the event that there is a malfunction at that level.		

TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE C - SERVICE
SINGLE LEVEL MINE; SINGLE DRUM HOIST; NO CLUTCH; MANUAL/AUTOMATIC
OPERATION: *A. Logging Procedures.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Enters information in log book. a) Date b) Name c) Type of trip (Manual/ Automatic) d) Cage released by (name) Next man trip 7:30-8:00	Maintain up-to-date history of hoist.	Procedure for making entries in Hoist Log Book.

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TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE C - SERVICE
SINGLE LEVEL MINE; SINGLE DRUM HOIST; NO CLUTCH; MANUAL/AUTOMATIC
OPERATION: *B. Automatic Operation.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. "Top Lander" operates cage.	Cage is controlled by Top Lander.	Location and function of switch to give top lander control.
a) Hoist under control of Top Lander, operator monitors controls and makes corrections.		Position and color of indicator lights.
b) Operator receives information from:	Provide monitoring information.	Location of information sources.
1) Gate open light and fault indicator		How to interpret information received.
2) Arrow and mark on drum.		
3) Depth indicator (position)		
4) Phone call from top or bottom lander or cage.		
2. If cage stops,		
a) Operator calls cage	Identify problem	
1) To determine if emergency stop, and		
2) To determine if people in cage are all right.		

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
b) Shift to manual operation	To get the hoist back to normal operation.	Location and operation of manual controls, control lever and speed selector.
1) Reset lever to manual position.		Bell code and communication procedure.
2) Men in cage will signal desired movement using bell when ready.		Bell code and communication procedure.
3) Return signal if correct. If signal incorrect reply with a long bell or use phone.		Meaning of speed selections Normal - - - Reduced speed Inspection speed - - - maximum load
4) Operate hoist in manual to carry out the ordered signal.		Manual operating procedures

TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE C - SERVICE
SINGLE LEVEL MINE; SINGLE DRUM HOIST; NO CLUTCH; MANUAL/AUTOMATIC
OPERATION: *C. Manual Operation.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Receives signal	Cage is to be moved.	Bell code.
a) Move speed selector as necessary	Select speed	Location/operation of speed selector.
b) Move lever (overspeed control prevents too high initial acceleration)	Start cage accelerating.	Meaning of selections.
c) Gauges [hoist rope speed; hoist motor Ammeter (two of these)].	Monitor speed of cage.	Location of Ammeter - normal load readings. Location of rope speed meter - normal rope speed

TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE C - SERVICE
SINGLE LEVEL MINE; SINGLE DRUM HOIST; NO CLUTCH; MANUAL/AUTOMATIC
OPERATION: *D. Make Checks of Equipment to Assure Safety Features Function Properly.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Slack Rope Switch		
a) Put cage support in shaft.	Prevent cage from lowering down the shaft.	Company procedures.
b) Move hoist control to "lower," release brake.		Hoist operation.
1) Emergency stop switch should open.		
2) If switch does not open, call foreman.	Obtain assistance	Name and location of foreman.
3) If switch does open:		
- Press by-pass switch	To reset slack rope switch.	Location and function of by-pass switch.
- Move control lever to hoist; and		Hoist operation.
- Tighten rope.		
2. Oil Flow to Bearings	To assure that hoist bearings are lubricated.	Location and operation procedures for oil pump.
a) Note pump running		Appearance of normal oil flow.
1) Shut down when hoist is secured.		
b) Note oil flow through sight glass		Appearance of normal oil flow.
1) If not sufficient, call foreman.	Obtain assistance	Location and identification of foreman.

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ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
3. Note Hoist ropes have: a) Fair leads and normal appearance.	Assure that hoist ropes are clear.	Normal appearance of ropes.
4. Note height of brake fluid and/or air/oil pressure. a) If level is too high—start air compressor. b) If level is too low--open and then close by-pass valve. c) If air/oil pressure is too high—open then close by-pass valve. d) If air/oil pressure is too low--start air compressor.	Assure that hydraulic system is at the right pressure.	Normal level of fluid in sightglass, or normal height of accumulator. Location of and procedures for operating air compressor.
5. Note Malfunction Lights. a) If a specific light is on, go to the part specified by the light. b) If general malfunction light is on, look at those parts not included in the specific lights.	To identify source of malfunction.	Location of malfunction lights. Appearance of light when fault is indicated. Location and appearance of General Malfunction light; parts that are indicated by General Malfunction light.
6. Note sound of hoist motor. a) If abnormal sound, call foreman.	To identify indication of malfunction. To obtain assistance.	Normal sound of Hoist Motor. Identification and location of foreman.

TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT - MINE C - SERVICE
SINGLE LEVEL MINE; SINGLE DRUM HOIST; NO CLUTCH; MANUAL/AUTOMATIC
OPERATION: *E. Emergency Procedure for Overtravel.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Note Fault Indicator light is on.		Location and meaning of indicator lights.
2. Note position of cage		Drum markings, depth indicator markings.
3. Determine from top/bottom lander who or what is in cage/skip.		Location and function of communication system.
4. Close overtravel by-pass switch.	To by-pass LILLY controller.	Location and function of overtravel by-pass switch.
5. Bring cage/skip back within the area between limit switches.	To bring cage/skip to landing.	
a) Switch to manual; close deadman switch.		Location and function of mode selector, deadman control, hoist and brake control.
b) Move control to hoist/lower; slowly release brake until cage/skip is back in the normal operating area; stop and set brake.		
c) Unload cage/skip.	Prepare for overtravel test.	
6. Test overtravel	To assure that the LILLY controller is working normally.	Function and location of the mode control switch, by-pass switch, depth indicator and communication plan.
a) Set mode control to test.		
b) Set cage control to by-pass.		
c) Press test start button--cage should come to landing and stop.		

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
7. If test fails notify foreman and electrician and shut down.	To obtain assistance	Communication system. Power switch.

TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE C - SERVICE
SINGLE LEVEL MINE; SINGLE DRUM HOIST; NO CLUTCH; MANUAL/AUTOMATIC
OPERATION: *F. Control of Production Hoist by Service Hoist Operator.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Service hoist operator takes limited control of the production hoist.	Allow service hoist and production hoist to operate with one person—controls are isolated.	Appearance of malfunctions on TV at dump area.
		Appearance of malfunctions on TV on production hoist control
Typical situation is:		Location and function of lights and buttons.
a) Bin feeder plugged; operator sees:	Indicators notify operator that bin feeder is plugged.	
dump bin light on		Location and color of dump bin light.
bin is full (TV screen)		TV appearance of bin full.
other product feeder light is on (TV screen)		TV appearance of other product feeder light "on".
Action:		
Call foreman to get help to top station	Get maintenance person to trouble area.	Name and location of foreman. Use of telephone/paging system.
Put service hoist on hold.	To prevent operation of other hoist.	Operation of service hoist.

TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE C - PRODUCTION
SINGLE LEVEL MINE; KOEPE WHEEL HOIST; NO CLUTCH; MANUAL/AUTOMATIC
OPERATION: *G. Maintenance.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Put power on manual.	Have manual control of the hoist.	Location and function of "Manual/ Automatic/Semi-Automatic" switch.
2. Raise skip to top in dump position.	Place skip in position where it can be greased.	Manual operation of hoist.
3. Have maintenance personnel grease skip.		
a) Use bell to inform operator to move to a different position for lube, or use phone.	Move skip as necessary for lubrication.	Bell code; telephone procedure.
b) Tell operator when to stop.	Stop the skip.	Bell code; telephone procedure.
c) Repeat (acknowledge) signal when using bell at top (collar)	Inform sender that signal was understood.	Bell communication procedure.
4. Oil rope.	Lubricate the entire length of the rope.	Manual operation of hoist in inspection mode.
a) operator moves skip slowly.		
5. Scale shaft	Assure that shaft is in good condition.	Person-to-person operating procedure.
a) Men on skip may radio to talk to operator.		Communication system.

TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE C - PRODUCTION
SINGLE LEVEL MINE; KOEPE WHEEL HOIST; NO CLUTCH; MANUAL/AUTOMATIC
OPERATION: *H. Manual Operation of Hoist for use as a Service Hoist.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Accelerate		
a) Gradually push/pull lever to accelerate.	Start skip moving.	How to start the skip without overloading the hoist motor. Location and function of controller. Lights/other signs that brake has released.
b) When near slowdown position, operator gives full power.	To make slowdown gradual.	Manual procedure for slowing--position to start slowdown.
2. Stopping of skip is automatic.		Neutral position of controller. Lights/other signs that indicate brake is on.

TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE C - PRODUCTION
SINGLE LEVEL MINE; KOEPE WHEEL HOIST; NO CLUTCH; MANUAL/AUTOMATIC
OPERATION: *I. Automatic Operation (Ore only).*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Operator contacts skip.	To make sure men are off the skip.	Telephone procedure and operation.
2. Skip is placed in dump position.	To line up for automatic operation.	Manual operation of skip.
3. Selector placed to automatic.	To start automatic operation.	Location and function of selector.
a) Note indicator light		Location and function of indicator lights.
4. Operator pushes start switch.	To start skip.	Location and operation of start switch.
5. Operator monitors meters.	To assure normal operation.	
a) If jump in Ammeter, presses Emergency Stop button.	To prevent damage if operation is abnormal.	Normal Ammeter readings. Position of Emergency Stop button.
b) If Bin Full light comes on, calls foreman.	To inform foreman of problem.	Location of Full Bin light. Location and identification of foreman.
6. Restart power.	To restart hoist operation after having used Emergency Stop button.	
a) Switch power to manual.		Function and location of Manual/ Automatic selector switch.
b) Bring skip to dump position.		Manual operating procedure for hoist.
c) Repeat "Automatic Operation" procedures [see C.1) through 4)].		Location and function of Automatic selector switch and Start button.

TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE D - SERVICE
SINGLE LEVEL MINE; SINGLE DRUM HOIST; NO CLUTCH; MANUAL
OPERATION: *A. Inspection at Start of Shift.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Reads log book	To learn of any equipment or operational problems; and determine the location of the working level.	Location of log book. Instructions for making entries.

TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE D - SERVICE
SINGLE LEVEL MINE; SINGLE DRUM HOIST; NO CLUTCH; MANUAL
OPERATION: *B. Operating the Hoist.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Prepares for descent to raise men to surface at the end of the shift.		
a) Receives phone communication.	Requesting hoist to a specific level.	Telephone procedure.
* 1) Checks cager list.	To verify that requestor is a qualified cager.	Location of qualified cager list.
b) Sounds bell signal.	To notify that hoist is beginning descent.	Bell code.
2. Descending trip.		
a) Closes Deadman Switch	Allow hoist to operate	Location and operation of deadman switch
b) Releases brake	Allow cage to move	Location of hand brake lever.
c) Monitors/controls speed.		
1) gradually accelerates	Increase cage speed.	Motor control operation.
2) Monitors FPM indicator	To monitor speed of descending cage.	Location of Rope Speed Meter.
3) Moves controller to full power.	To increase speed to cruise.	Motor control operation.
d) Begins braking procedures		
1) Start reducing power by controller	To begin deceleration	Motor control operation.
2) Begin braking by using dynamic brake.	To reduce descent speed of cage.	Dynamic braking procedure.

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* Any request for cage must be phoned in so that cager can be identified as qualified.

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
3) Applies hydraulic brake--gradually.	To further slow the cage.	Brake lever function and operation.
4) Receive signals from men on landing and from cager.	To ensure stopping at the specific location.	Bell code procedure.
5) Put motor control in neutral; apply brake fully.	To bring hoist to a stop.	Motor and brake control operation.
3. Ascending trip.		
a) Receive bell signal from cager.		Bell code and communication procedure.
1) responds with same bell signal.	To acknowledge receipt of signal.	Bell code and communication procedure.
b) Receive bell signal		
1) Respond with 1 bell.	To acknowledge receipt of signal.	Bell code and communication procedure.
c) Begins acceleration for ascending trip.		
1) Moves power up three notches on controller (a total of 8 notches)	Apply power to hoist motor.	Location and operation of motor control.
2) Release brake--gradually	Allow cage to move freely.	Location and operation of brake control.
d) Monitors depth	To determine the rate of ascent.	Location of depth indicator; meaning of markings thereon.
1) Increase acceleration control to 8th notch.	Attain and hold cruise speed.	Controller operation.

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ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
e) Begins deceleration procedures. Same as 2.d)1),2),3).		
1) receives 1 bell signal	To order the cage stopped.	Bell code and communication procedure.
2) sees red light indicator	Stop signal	Meaning of signal.
3) sets hydraulic brake	To stop the cage.	Brake operation
4) receive 3 bell signal	To assure that cage will not be moved.	Bell code.
5) receives 2-2 bell signal	To release cage.	Bell code.
6) hoistman moves cage 10-12' below collar.	To ensure that no men will enter cage.	Procedure when cage/skip is not in use.
7) operator awaits signal	To release cage at bottom.	Bell code and communication procedure.
4. Transport materials.		
a) Operator verifies cager is qualified.	To assure correct signal	Cager Qualification list.
b) Receives bell signal		
1) replies with same signal	To acknowledge receipt of signal	
c) Begins acceleration	To move cage in response to signal.	Motor controls and operating procedures.
1) accelerates/decelerates faster with materials		
a) accelerates to 4 notches unless heavy load.		Operating procedures for heavy loads.

TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE D - SERVICE
SINGLE LEVEL MINE; SINGLE DRUM HOIST; NO CLUTCH; MANUAL
OPERATION: *C. Emergency Procedures for Overtravel and Overspeed.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Overtravel (top and bottom)		
a) Engage back-off switch.	To return skip to normal operating area after it has gone through overtravel switch.	Location and function of back-off switch.
b) Move cage (using controller) to within operating area.		Motor controller operation.
c) Disengage back-off switch.		
2. Overspeed		
a) When Lilly cuts off power:		
1) Set brake and put controller to neutral position.	Hold skip/cage in position	Motor controller and brake operation.
2) Reset "Power On" switch.	Restore power.	Location and operation of "Power On" switch.

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TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE D - SERVICE
SINGLE LEVEL MINE; SINGLE DRUM HOIST; NO CLUTCH; MANUAL
OPERATION: *D. Safety Check.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Enters all activities and problems encountered in log book.	To inform next shift of problems.	Standard company logging procedures.
2. Overspeed		
a) Put power to neutral and allow skip to coast (same as C. Emergency Procedures for Overtravel and Overspeed)	To test overspeed control.	Brake and motor control functions.
3. Communications check	To test communication	Communication systems and procedures

TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE E - PRODUCTION
SINGLE LEVEL MINE; DOUBLE DRUM HOIST; SINGLE CLUTCH; AUTOMATIC
OPERATION: *A. Inspection and Check at Start of Shift.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Confer with prior shift operator.	To ascertain condition of brakes, limit of notch, communication system.	General knowledge of hoist.
2. Move skip at mechanic's direction.	To enable inspection and lubrication.	
a) Mechanic calls on C.B. radio to raise/lower the skip North/South for a specified number of feet.	To communicate between mechanic and hoistman.	Communication system and procedure.
b) Receives informal acknowledgement.		
c) Selector switch to manual.	Put hoist in Manual operation.	Location and function of Operation Selector switch.
d) Move speed selector switch to 1/2	Start skip/cage moving	Location and function of Speed Selector Switch.
e) Push brake lever (release) slowly	Release brake.	Brake control location and function.
f) Apply power using Ammeter as a guide.	Accelerate to desired speed.	Location and operation of motor control. Location and maximum allowable reading on Ammeter.
g) Maintain power until mechanic requests stop.	Continue movement.	
h) Pull brake and put power to neutral, simultaneously.	To stop skip at destination.	Stopping procedure using brake and motor control.

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TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE E - PRODUCTION
SINGLE LEVEL MINE; DOUBLE DRUM HOIST; SINGLE CLUTCH; AUTOMATIC
OPERATION: *B. Prepares for Production Trips.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Contact crusher operator by phone.	Inform him the hoist is ready to operate.	Communication system and procedure.
2. Crusher operator replies affirmative.	Crusher operator signifies that he is ready.	
3. Lower north skip to one pocket.	Position one skip at loading level. (Crusher cannot operate until skip is in position.)	Operating routine and hoist characteristics.
a) Release brake		Location and function of brake control.
b) Apply power gradually until full speed is attained; uses Ammeter or FPM meter as guide.	Begin and maintain acceleration of skip.	Function and location of motor control; location of FPM meter and Ammeter.
c) Monitors depth gauge (drum type)	Determine depth of skip.	Location of depth gauge, meaning of markings thereon.
d) Begin to reduce power; decelerate.	Prepare to stop.	Hoist operating controls and braking procedures.
e) When bottom pointer light comes on, sets brake fully and puts controller to neutral, simultaneously.	Stop skip in loading position.	Hoist operating controls and procedures; location and meaning of indicators.
4. Call crusher operator to turn feeder on.	Load skip.	Communication system and procedure.
5. Set selector switch to transportation	Line up hoist for automatic operation	Location and function of selector switch.

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
a) Release brake	Begin acceleration of skip.	Location and operation of brake control.
b) Press start button	To allow North skip (empty) to rise while South skip lowers to bottom feeder and begins to load.	Location and operation of start button.
c) Observes bottom position light.	Determine when skip is full. If light is on--skip is loading; when light is out--skip is full.	Location and purpose of bottom position light.

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TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE E - PRODUCTION
SINGLE LEVEL MINE; DOUBLE DRUM HOIST; SINGLE CLUTCH; AUTOMATIC
OPERATION: *C. Automatic Operation.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Push selector lever to automatic.	Hoist is in automatic mode.	Location and operation of selector lever.
2. Press start button.	Start automatic operation.	Location of "Automatic" button and indicator light.
3. Operator observes Ammeter.	To monitor load	Location of Ammeter.
a) if it draws more than 1300 amps:	Indication of a problem.	Permissible load.
1) Operator moves selecter lever to off.	Stop operation.	Location and operation of selector lever.
2) Calls crusher operator to check skip.	Identify problem.	Communication system and procedure.
3) Moves selector to "Manual" mode and raises skip slowly.	Manually raise skip to dump position.	Location and operation of selector lever.
4) Brings skip to top and dumps load.	Empty skip for inspection.	Motor control operation; braking procedures.
5) Holds skip at top and shuts door.	Assure skip is inaccessible until inspected and released.	Company procedures.
6) Contacts foreman.	Obtain assistance to troubleshoot operation.	Identification and location of foreman.
4. Resume operations when authorized.		
5. Repeat test run, if required.	Assure proper operation of hoist.	Company procedures.

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TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE E - PRODUCTION
SINGLE LEVEL MINE; DOUBLE DRUM HOIST; SINGLE CLUTCH; AUTOMATIC
OPERATION: *D. Monitors Brakes.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Checks oil pressure gauge.	Ensure pressure at 400-500 lbs.	Location and function of oil pressure gauge, normal pressure requirements.
a) If pressure is low, check brakes.	To look for oil leaks.	Appearance of low oil pressure; procedures for checking brakes; observance of leaks.
b) If leak is observed, call foreman.	To report leak and obtain assistance.	Location and identification of foreman.
1) Foreman will inspect and shut down or authorize resumption of operations.		
c) If no leaks are observed; switch to other pump.	To see if pressure comes up.	Location and function of oil pressure gauge.
1) If pressure is still down, report to foreman.	To obtain assistance	Identification and location of foreman.

TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE E - PRODUCTION
SINGLE LEVEL MINE; DOUBLE DRUM HOIST; SINGLE CLUTCH; AUTOMATIC
OPERATION: *E. Inspection.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Checks motors.		
a) Puts hand on motor housing.	To check for motor running hot.	Normal temperature of motor.
1) If too warm, calls foreman and follows his instruction.	Obtain assistance if trouble is indicated.	Location and identification of foreman.
2. Checks bearings using temperature gauge.	Determine if bearing temperature is abnormal; if so, obtain assistance.	Normal temperature of bearings; how to read gauge.
a) If hot, calls foreman.		Identification and location of foreman.
3. Inspects clutch.		
a) Checks temperature by touch.	Determine if clutch is over heating;	Normal temperature of clutch.
1) If hot, calls foreman.	Obtain assistance	Identification and location of foreman.
4. Inspects rope for dryness.		Normal appearance of rope.
a) If rope is dry, calls maintenance foreman.	Obtain assistance.	Identification and location of maintenance foreman.
5. Checks ventilation system.	Assure adequate ventilation.	
a) Inspects graph	Determine the actual flow of air.	Location of ventilation graph; how to read it.
b) If <u>one</u> fan is off, operator notifies work crews.	Advance warning that ventilation system is operating marginally.	Communication system.

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
c) If both fans are off:		
1) Notifies crews.	Warning that ventilation system has failed and make preparation to evacuate.	Communication system for emergency.
2) Lower hoist to bottom of mine and stand by.		Emergency evacuation procedures; motor control operations; braking procedures.
3) Calls crusher operator	To report the failure.	Communication system and procedures.
4) Calls power house	To report the failure.	Communication system and procedures.
6. Generator inspection.		Location and normal operation of generators.
a) If generator is stopped:		
1) Checks flag above start switch.	Check failure indicator.	Location and meaning of warning indicator.
a) If flag is up, reset lever.	Prepare to start generator.	
b) Press start button.	Attempt to start generator.	Location and function of generator start switch.
1) Should show X amps	Monitor generator output	Normal amp level of generator.
2) If fails to start, tries again.	Repeat start procedure.	
a) If second attempt fails to start, calls power house.	Obtain assistance	Communication system and procedures.
b) Calls electrician	Obtain assistance	Identification and location of electrician
3) If only one generator starts, shut down and call electrician	Obtain assistance	Identification and location of electrician

TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE F - SERVICE
SINGLE LEVEL MINE; DOUBLE DRUM HOIST; SINGLE CLUTCH; MANUAL
OPERATION: *A. Inspect Hoist at Start of Shift.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. "Released Cage" is emptied and dropped to where no one can get on.	To perform inspection without endangering men.	Operation of hoist controls.
2. Talks to relieved man on prior shift and checks log book.	To discuss problems that were entered in log book; to learn of things to be alert for (e.g., motor heating, electrical malfunctions)	Logging requirements.
3. Checks safeties: • brakes • upper and lower overtravels • rope	To assure that safety devices operate properly.	Company procedures/State Regulations for check of safety devices prior to normal operation.
a) Brakes		
1) Turn brake test lever to "right brake release" - if released, counter-balance goes up.	Test right brake release.	Location and function of brake test lever
2) Turn brake test lever to "left brake release" - if released counter-balance goes up.	Test left brake release.	Brake control location and function.
b) Check overtravel	Test overtravel device.	
1) Moves cage to bottom of mine.	Test lower limit switch.	Location and function of hoist controls
a) If overtravel working properly, power will go off:	Test is satisfactory	

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1) Then must hold back-out lever to back-out position.	Provide power to restore normal operation.	Location and function of back-out lever.
2) Press safety reset button		Location and purpose of safety reset button.
3) Apply power via lever.	Move cage to normal position.	Location and function of back-out lever.
b) If overtravel is not engaged:	Test fails.	
1) Operator will see that bottom stop point is passed (via mark on drum or depth indicator)		
2) Operator will stop hoist himself	Stop movement manually.	Motor control to manual; location and operation of brakes.
3) Calls foreman	Obtain assistance	Communication system; location and identification of foreman.
2) Reverse procedure for upper overtravel check.		
c) Checks ropes		
1) Hoists slowly		Manual operation of hoist in inspection mode.
2) Visually inspects (from hoist house)	To ascertain if rope is frayed.	Appearance of rope; degree of wear for normal operation.

TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE F - SERVICE
SINGLE LEVEL MINE; DOUBLE DRUM HOIST; SINGLE CLUTCH; MANUAL
OPERATION: *B. Operates Hoist Controls*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Take crew down to working level.		
a) Calls on phone or pager for cage.		Communication system and procedures.
b) Foreman acknowledges call.	To inform that cage is ready.	Communication system.
c) Operator presses circuit reset button.	Get power on.	Location and function of manual/automatic selector switch; circuit reset button.
d) Energize controller.	Power to controller.	
e) Moves until brakes are pressed (dragging slightly)	Power to motor.	Function of controller lights and other signs that brake has released.
f) Continue until brakes fully released (audio signal)	Brakes released.	
g) Applies full power.	Full power is available to the hoist.	Procedures for automatic operation.
h) Operator watches rope speed	Recognize an overspeed situation, when in automatic go to manual operation, complete the trip and obtain assistance.	Location and function of FPM indicator.
1) If speed exceeds 750 FPM		Normal rope speed for safe operation.
a) operator will back off power		
b) complete trip		Manual procedures for slowing and stopping hoist.
c) call foreman		Communication system; location/ identification of foreman.
2. Decelerate man-trip.		Stopping procedure using brake and motor control.
a) Foreman on cage will give signal.	To signal that cage is approaching destination.	Communication system and procedures.

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
b) Operator acknowledges with same signal	Signal is received	Communication system.
c) Operator will monitor depth indicator and listen for warning bell.	To determine when approaching destination.	Location and function of depth indicator for slowing; meaning of warning bell.
d) Operator brings control lever back to about 1" away from neutral.	Start slowing.	Location and function of controller lever for slowing procedures.
e) Continues slowing until depth indicator shows cage at station.		Location and function of depth indicator; meaning of marks.
f) Brings power to neutral	Power of brake sets automatically; cage stops	Neutral position of controller to await new destination.
g) Operator will signal	To signal that cage is stopped.	Communication system and procedures.
h) Cage will acknowledge	Signal received.	
i) Cage will remain at station until released or belled to another station from cage.		
3. Operator may use Amp meter as a malfunction indicator.		Location and function of Ammeter.
a) A surge of amps shows that there is an extra strain on motor	Identify conditions where there is an excessive load on the motor.	Maximum allowable reading on Ammeter.
177 1) If that happens, system will institute protective stop		173

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
2) Hoistman must check fault board and either fix problem himself or call mechanic.	Identify the trouble. Obtain assistance	Location and function of fault board; identification of warning lights, indicators. Identification and location of mechanic.

TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE C - (8% Slope) PRODUCTION/SERVICE
MULTI-LEVEL MINE; SINGLE DRUM HOIST; NO CLUTCH; MANUAL
OPERATION: *A. Inspect Hoist at Start of Shift.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Manually raises balls on Lilly controller	To test overspeed control.	Location and function of Lilly controller.
2. Hoist empty "trip" at "creep" speed (100 fpm) past dump position toward end of track.	To test overwind control.	Location and function of motor control lever, FPM indicator.
a) Monitor depth gauge		Location and function of depth gauge and the meaning of the marks thereon.
b) If Lilly fails to operate as arrow shows nearing end of track, cut power and apply brake.	To prevent trip from rolling off	Depth indicator, motor control lever, braking procedures.
c) Call mechanic if overwind fails to operate.		Communication system; identify and locate mechanic.
3. Visually inspect hoist anchorage.	To identify loose bolts.	
a) May tap bolt(s) with hammer.	To determine if "dead" sound occurs--indicating loose bolt.	Appearance and normal sound of secure bolts.
b) May make contiguous chalk marks on nut and bolt.	To provide a means of identifying loose nuts.	
4. Observe position of depth indicator after rope rider has signalled for stop.	To determine accuracy of depth indicator.	Function and location of depth indicator.
Notify mechanic if indicator is off	To obtain re-calibration.	Communication system and identity and location of mechanic.

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
5. Determine that the bell signals are being made and are in accordance with the rope rider's anticipated instructions.	To determine working order of bell signal.	Bell system and code.
6. Visually observe number of wraps of rope around drum when trip at lowest position.	To determine that at least 3 wraps remain.	Normal number of rope wraps around the drum at lowest location in shaft.
7. Visually inspect lines, connections, reservoirs of hydraulic brake system.	To identify points where hydraulic fluid may be leaking.	Location and function of hydraulic brake system; observance for leaks; loose connections.
a) May manually manipulate connections.	To determine if loose.	
8. Confers with prior shift operator and reads log book.	To ascertain condition of hoist and learn of any operational/equipment problems.	Location of log book and purpose of it.
9. Visually examines wraps of rope that are on drum.	To determine if rope is dry and in need of lubrication.	Normal appearance of condition of rope.

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TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE - G (8% Slope) PRODUCTION/SERVICE
MULTI LEVEL MINE; SINGLE DRUM HOIST; NO CLUTCH; MANUAL
OPERATION: *B. Lubricate Selected Components.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Oil rope	To minimize friction, crushing, abrasion.	Company procedures for oiling rope.
a) Hoist empty "trip" to man-loading station at top, if not already there from last shift. Put power control to neutral and set hydraulic brake.	To get maximum amount of rope onto drum. To ensure drum is stationary.	Location and function of motor control lever and braking system. Type and normal mount of lubricants needed to perform oiling procedures.
b) Carry one 5-gal can of oil to position near top of drum.		
c) Pour oil evenly over rope lays at top of drum.		
2. Manually apply grease to mechanical connections on hydraulic brake arm.	To ensure smooth operation and to minimize friction and wear.	Manual procedures for greasing hydraulic brake arm, Lilly controller; type of lubricant used.
3. Manually apply grease to gears on Lilly controller.	To ensure smooth operation and to minimize friction and wear.	
4. Pour oil on shaft connecting motor to drum.	To ensure smooth operation and to minimize friction and wear.	Oiling procedure.

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TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT - MINE - G (8% Slope) PRODUCTION/SERVICE
MULTI-LEVEL MINE; SINGLE DRUM HOIST; NO CLUTCH; MANUAL
OPERATION: *C. Operate Hoist.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Lower men to working level(s) at start of shift.		
a) Hears bell signal and interprets meaning.		Bell system and code.
b) Operates controls to start and accelerate man-trip downward.		
1) Release deadman override.	To engage deadman circuit.	Location and function of deadman switch.
2) Places right foot on deadman pedal on floor.	To ensure that if during man-trip operator becomes incapacitated, power will cease and trip will stop.	
3) Moves hoist control lever to neutral position.	To reduce the power applied to hoist motor.	Location and function of hoist control lever.
4) Pulls both magnetic brake control levers from "off" to position #1 (minimum brake application)	To provide a braking force slightly less than weight of man-trip; permits gradual acceleration of downward trip.	Magnetic brake lever operations and function.
5) Pushes hydraulic brake lever all the way to full release.	To permit man-trip to begin descending by force of gravity.	Location and function of hydraulic brake controls.
c) Monitors/controls cruise speed of descending man-trip.		
1) Watches arrow on FPM indicator.	To monitor speed of descending man-trip.	Location and function of FPM indicator.

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
2) Pulls back magnetic brake coarse control toward but not into second position.	To adjust speed of man-trip.	Braking procedures.
3) Returns lever to 1st position.	To increase descent speed toward 600 FPM.	Braking procedures.
4) May pull coarse brake control into second position and use fine brake control lever to control speed.	To control man-trip descent speed at steep parts of slope.	Braking procedures.
5) Return coarse and fine magnetic brake control levers to 1st position to control speed.	To control rate of descent after steep part of slope is passed.	Braking procedures.
d) Operates controls to decelerate and stop hoist.		
1) Hears bell signal and interprets meaning.		Bell system and code.
2) Observes depth indicator.	To determine if man-trip is going all the way to bottom.	Location and function of depth indicator.
3) At 500 ft. before bottom, pulls back on magnetic brake levers.	To decelerate.	Location and function of depth indicator; braking procedures.
4) Pulls both magnetic brake levers to 3rd notch.	To apply full magnetic braking power to descending man-trip.	Braking procedures.

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ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
5) Pulls hydraulic lever to "full on" position (last detent)	To apply hydraulic brake.	Braking procedures.
6) Pushes both magnetic brake levers fully forward to off position.	To release magnetic brake.	Braking procedures.
2. Lower empty trip from dump.		
a) Hears bell signal and interprets meaning.		Bell system and code.
b) Operates controls.	To start and accelerate empty trip downward.	
1) Presses dead-man override button.	To disengage dead-man circuit.	Location and function of dead-man override button.
2) Puts motor control lever to neutral position.	To permit empty trip to begin descending by force of gravity.	Location and function of motor control lever.
3) Pushes both magnetic brake levers to off position.		Magnetic braking procedures.
4) Pushes hydraulic brake lever to off position.		Hydraulic braking procedures.
5) Watches FPM indicator	To monitor speed of descending trip.	Location and function of FPM indicator.
6) Pushes motor control lever all the way forward.	To provide maximum unwind speed to drum.	Motor control lever operations.

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
7) Depresses foot pedal at left side of console.	To override automatically timed application of motor power.	Location and function of foot pedal.
c) Operates controls.	To decelerate and stop.	Hoist operating procedures.
1) performs 1.d)1)-4).		
3. Position descending empty trip into "drop-in."		
a) Hears 2-2 bell signal and interprets meaning.		Bell system and code.
1) Visually examines depth indicator.	To identify which drop-in rope rider intends to have trip enter.	Location and function of depth indicator.
b) Operates hoist controls	To decelerate empty trip to drop-in entry speed.	Hoist control procedures.
1) Pulls motor controller to neutral position.	To decelerate to drop-in entry speed.	Motor control procedures.
2) Pulls back on coarse magnetic brake lever.		Braking procedures.
3) Watches FPM indicator.	To determine when drop-in entry speed is reached.	Function and location of FPM indicator.
4) Alternatively pulls back and releases coarse lever.	To maintain desired entry speed.	Braking procedures.
c) Operates hoist controls	To stop empty trip in drop-in.	Hoist control operations
1) Hears one (1) bell signal and interprets meaning.		Bell code and system.
2) Performs 1.d)3)-4)		

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ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
4. Raise men to surface at end of shift or to higher level.		
a) Hears bell signal and interprets meaning.		Bell system and code.
b) Operates controls to start and accelerate man-trip upward.		Hoist control operations.
1) Releases deadman over-ride button (if over-ride is set).	To engage deadman circuit.	Location and function of deadman override button.
2) Places right foot on deadman pedal on floor.	To ensure that if, during man-trip, operator becomes incapacitated, power will cease and trip will stop.	Location and function of deadman brake procedures.
3) Pulls hoist control lever to 2nd position after neutral.	To take up slack in rope.	Hoist control operations.
4) Push both magnetic brake levers and hydraulic brake lever to off position.	To permit man-trip to begin ascending by motor/drum action.	Braking procedures.
5) Listens to sound of drum and hoist motor.	To determine when drum, and hence man-trip reaches a constant speed.	Normal sound of drum and hoist motor.
6) Pull hoist control lever to 3rd position.	To accelerate to cruising speed.	Hoist control procedures.
c) Operates controls.	To maintain cruising speed.	
1) Leaves motor control lever at 3rd position.	To provide smooth, even ride upward.	Motor control operations.

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
d) Operates controls.	To decelerate and stop ascending man-trip.	
1) Hears bell signal and interprets meaning.		Bell system and code.
2) Watches depth indicator.	To determine where rope rider wants to stop.	Location and function of depth indicator.
a) Pushes motor control lever to neutral position.	To begin deceleration.	Motor control lever procedures.
b) May gradually push motor control lever to neutral position.	To begin gradual deceleration and keep man-trip from running over slack rope at level places.	Motor control lever procedures.
3) Performs 1.d)3)-4).		
5. Raise product trips.		
a) Hears signal and interprets meaning.		Bell system and code.
b) Operates hoist controls.	To start and accelerate product trip.	
1) Pull motor control lever to 1st position.	To apply power to drum and to remove slack from rope.	Motor control lever.
2) Watch rope leading to drum.	To determine when slack is taken up.	Normal position of rope leading to drum when slack is taken up.
3) Push both magnetic brake levers and hydraulic brake lever to off positions.	To permit start of upward movement.	Braking procedures.

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
4) Pull motor control lever to 2nd position.	To begin acceleration upward.	Motor control lever.
5) Listens to sound of motor.	To determine when maximum speed at second control lever position is reached.	Normal sound of motor when maximum speed at second position is reached.
6) Pulls motor control lever to 3rd position.	To continue acceleration upward.	Motor control lever.
7) Listens to motor drum sound while watching FPM indicator.	To determine when maximum speed at 3rd control lever position is obtained.	Normal sound of motor when maximum 3rd notch speed is reached; location and function of FPM.
8) Pulls motor control lever to 4th (maximum) position.	To accelerate at cruising speed.	Motor control lever.
c) Operates hoist controls	To decelerate ascending product trip.	
1) Watches depth indicator.	To determine if product trip is approaching dump.	Location and function of depth indicator
2) Pushes motor control lever to 2nd position.	To begin deceleration.	Motor control lever.
3) Intermittently pulls coarse magnetic brake lever from off to position 1/2 way to 1st position.	To keep FPM at 500 feet.	Braking procedures to keep FPM at 500 feet.
d) Operates hoist controls	To stop ascending product trip in dump.	
1) Watches depth indicator.	To determine if product trip is approaching end of track.	Location and function of depth indicator

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ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
2) Puts power to neutral and applies brakes.	To prevent trip from rolling off track.	Braking procedure as applied at end of track.
3) Hears bell signal and interprets meaning.		Bell system and code.
4) Pushes motor control lever to neutral position.	To turn off hoisting power.	Motor control on off power.
5) Performs 1.d)3)-4)		
6. Dumping the cars.		
a) Hears bell signal and interprets meaning.		Bell system and code.
b) Pushes hydraulic brake lever to off position.	To lower a car of product trip into dump position.	Hydraulic brake lever procedures.
c) Pushes coarse magnetic brake lever to off position and immediately begins to pull back slightly.		Magnetic brake lever procedures.
d) Hears bell signal and interprets meaning.		Bell system and code.
e) Pulls magnetic brake levers to full stop.	To stop car at dump position.	Magnetic brake procedures.
f) Pulls hydraulic brake lever to full stop.		Hydraulic brake procedures.
g) Repeat 6.a)-f)	To empty all cars in product trip.	

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TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE H - PRODUCTION
SINGLE LEVEL MINE; DOUBLE DRUM HOIST; SINGLE CLUTCH; MANUAL
OPERATION: *A. Inspect Hoist and Man Cage at Start of Shift.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Manually raises/lowers cage.	Assure drive system is working.	Manual operating procedures.
2. Checks overspeed.	Assure overspeed device is working.	Location and function of overspeed trip.
3. Hoist empty trip past dump position	Test overwind control.	Hoist operating procedures.
4. If men are ready to descend to working level, prepare for descent.		
5. Otherwise, leave cage in middle and go to production hoist.		
6. Oil Inspections.		
a) Check bearings on motors.	Assure oil supply to motors.	Lubrication procedures.
1) Oil cups should be full 1/4 inch from the top.		Measurement standards.
2) If too low, add oil.		Type of oil used; location of oil storage.
b) Check bearings on drums.	Assure oil supply to drums.	
c) Check oil on drive gears.	Assure oil supply to drive gears.	
7. Inspection of rope.	Ensure rope is wet, otherwise lubricate.	Appearance of properly lubricated rope; appearance of dry rope.
a) Moves one skip to the top and one skip to the bottom.		Hoist operating procedures.
1) uses big broom to oil one rope.		
2) reverse and repeat.		

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ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
8. Perform test run.		
a) Moves each skip down/up (empty)	Check for clear shaft and check motors.	Hoist operating procedures
1) Check for lost motion in depth indicator.	Check depth indicator.	Normal appearance and operation of depth indicator.
2) Check for unusual noise such as gears grinding, bearing oil slinging.	Assure hoist is mechanically correct.	Normal running noise of hoist mechanism.
3) check for brakes slipping, too loose, glazing, low air.	Assure brakes are operable.	Normal appearance of brakes.
a) Call mechanic or, if air low, charge system.	Obtain assistance.	Identify and locate maintenance personnel.

TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE H - PRODUCTION
SINGLE LEVEL MINE; DOUBLE DRUM HOIST; SINGLE CLUTCH; MANUAL
OPERATION: *B. Emergency Procedure for "Air Brakes Out"*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Turn pump off with brake handle.	Stop hydraulic pump.	
2. Turn off valve at end of hose.		
3. Hook up air hose (screwfitting) from compressor to hydraulic brake fluid reservoir.	Connect air compressor to air reservoir.	Location and operation of the hydraulic/air system lines, cut-off valves, bleed valves.
4. Use wrench to open (crack)		
a) Bleed valve at bottom of reservoir until sound diminishes.	Bleed off remaining air.	
b) Pressure gauge will go to zero.		Location of pressure gauge.
5. Close bleed valve.	Line up valves to replenish air supply.	
6. Opens air valve at compressor.		Compressor valve location.
7. Opens air valve to reservoir.		
8. Opens air hose valve.		
9. Run compressor until pressure is 200 lbs (compressor should stop automatically).	Recharge air chamber	Compressor start/stop controls.
10. Close valve on air line		
11. Disconnect air line and store.		
12. Turn brake pump on.	Restart hydraulic pump.	Location and operation of hydraulic pump controls.

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TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE H - PRODUCTION
SINGLE LEVEL MINE; DOUBLE DRUM HOIST; SINGLE CLUTCH; MANUAL
OPERATION: *C. Operates Hoist Controls.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Lowers east skip		
a) Pulls power lever toward operator 2 notches.	Start east skip down	Hoist operating procedures.
b) Pushes brake handle 3/4 way to off.	Release brake.	Location and function of motor controller and brake lever.
c) Watches west depth indicator	Gauge progress	Location and function/markings on depth indicator.
1) reduces power to off as it enters dump.	Slow travel of the skips	
2) applies brake when in dump position.	Stop the skips.	
d) Watches for red light on east side. Also watches depth indicator.	To know when the skip is low enough for loading	Location and meaning of light indicators.
1) If depth indicator shows skip at bottom and red light is not on, lower very slowly until red light goes on.		
a) When other skip is in dump position a blue light is shown. Rope stretch will affect simultaneous lighting of both lights.		
e) Operator concentrates on red light when it goes on.		
f) Pulls brake full back.		

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ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
2. Raising full skip (east)	Raise loaded skip to dump; lower empty skip to load position.	Hoist operating procedures
a) Looks for green light (east/ west)--means skip is full and ready to raise.		Meaning of indicator lights.
1) If light is not working, receives phone call from skip loader.		
b) Push motor controller 3 notches.		
c) Ammeter shows 1500 amps		
d) slowly releases brake		
e) monitors west depth indicator until it passes "entering dump"	To know when west indicator goes past entering dump line.	
f) Push motor controller to full power.		
g) Release brake fully		
1) Ammeter will go to 2000		
2) Ammeter reading is an indication of the load.	Estimate load weight from power requirements	Ammeter readings under various loading conditions.
3) If too low, call foreman to check loader (load is light)	Obtain assistance.	Location and identity of foreman.
4) As load increases, reduce power earlier as loaded skip enters dump area.		

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ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
h) Decelerate and stop raising skip (loaded)	Preparation to stop skip.	Hoist operating procedures.
1) Pull controller back from 6th (full) notch to 2nd notch.		
2) Intermittently applies brake.		
a) From full brake to 1/2	To gradually slow skip to creep speed.	
3) Monitors depth indicator	To determine when inside dump marks.	
4) Pulls power to neutral when inside dump area.	Slows skips.	
5) Pulls hydraulic brake on full when red light goes on for skip in load area.	Lock skip in load position.	Meaning of indicator lights.

TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT - MINE H - PRODUCTION
SINGLE LEVEL MINE; DOUBLE DRUM HOIST; SINGLE CLUTCH; MANUAL
OPERATION: *D. End of Shift Activities*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. For mid-shift:		
a) Calls skip loader at bottom	To notify him to empty out "scales" (contains & weighs salt, then dumps into skip) (2 scales)	Communication system and procedure.
1) Empty scales:		Standard operating procedures.
a) Empty scale into east skip, reload scale.		
b) Raises/dumps		
c) Raises/dumps other skip; positions both skips in midshaft by:	Skips secured away from load/landing stations.	Hoist operating procedures.
-- power to neutral		
-- release brake		
-- skips should balance		
-- press power off button	Power is cut off	
-- brake set		
b) Enters maintenance activities, oil, lubrications into log book.	Record activities	Logging procedures
2. For 1st Shift:		
a) Tells relief operator about any problems.	Pass along relevant information.	Relieving procedure.
1) Leaves a note for foreman regarding any problems.	Obtain required assistance.	Identification - probable location of foreman.

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
b) Leaves skip at bottom. 1) Power to neutral 2) Both brake levers on full (pull).	Leave skips out of the way Skips are secured.	Hoist operating procedures

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TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE I - SERVICE
SINGLE LEVEL MINE; SINGLE DRUM HOIST; NO CLUTCH; MANUAL
OPERATION: *A. Inspection and Check.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Dry run made at end of inspection.	To ascertain condition of hoist.	Characteristics of hoist operating procedures.
2. Reads "trip sheet"	To see if test run was made; if not, conduct test run.	Company policy.
3. Observes depth indicator	To see position of cage.	Location/markings of depth indicator.

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TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE I - SERVICE
SINGLE LEVEL MINE; SINGLE DRUM HOIST; NO CLUTCH; MANUAL
OPERATION: *B. Operates Hoist Controls.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Lower cage to mine level		
a) Sounds 2-2-2 bells	To alert that cage is being lowered to mine level by operator.	Bell code.
b) Release mechanical brake.	To begin descent	Brake operation.
c) Steps on deadman switch.	To ensure that if, during man trip, operator becomes incapacitated, power will be cut off and brakes set.	Location of deadman switch.
d) Push mechanical brake slightly.	To move cage/drum to 1300 mark.	Drum markings.
e) Pulls all the way back on brake lever.	To stop cage on mine level.	Brake lever operation.
2. Hears bell signal indicating men to be raised to surface at end of shift.		
a) Receives 3 bell signal		Bell code.
b) Reports with same signal	To acknowledge receipt of and understanding of signal.	Bell code operating procedures.
c) Cage acknowledges with same signal.		
3. Operates controls to start man-trip upward.		
a) Places foot on deadman switch.	To ensure that if, during man-trip, operator becomes incapacitated, power will cease and trip will stop.	Location of deadman switch.

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
b) Move controller clockwise to 3rd position while gradually releasing mechanical brake.	To begin acceleration of man-trip.	Motor controller location/operation. Brake lever location/operation.
c) Release brake entirely.		
d) Move controller clockwise to position 10 when depth indicator passes warning bell switch on Lilly control.	To maintain cruise speed.	Position of warning bell switch on depth indicator.
4. Decelerate/Stop ascending trip.		
a) Listens for warning bell.	To determine when trip is approaching destination.	Sound of warning bell; meaning of warning bell.
b) Begin moving controller counter-clockwise at approximately one notch per second until it reaches 3rd notch (if light load) or 4th (if heavy load).	To begin deceleration.	Controller function.
c) Observe depth indicator look at drum for stop mark.	To note when indicator position is approximately 1" from the stop mark.	Location and meaning of markings on depth indicator.
d) Pull back on manual brake to within 4-6" of full brake.	Slow skip.	
e) Pull brake lever to full stop when drum mark shows cage is at destination.	To stop cage at destination.	Brake lever function.

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
f) Steps off deadman switch		
g) Puts power to neutral.	To turn off hoisting power.	Controller function.
h) Hears and acknowledges 1 bell signal.		Bell code.
i) Receives acknowledgment and signal of 4 bells.		Communication system operation and bell code.
j) Moves cage above landing	To ensure no one enters cage.	Hoist operation.
Note: Once shift men are raised and cage is positioned above, the operator may not receive any bell codes--the requests must be made by phone; if he hears bells, he goes to shaft and looks to see who is signaling and what he wants.		
5. Hears bell signal indicating men to be lowered to working level.		
a) Acknowledges bell signal.	To acknowledge receipt of signal.	Bell code and communication system.
b) Hears bell signal for descent.		
c) Acknowledges bell signal	To acknowledge receipt of signal to descend.	
6. Operates controls to start and accelerate man-trip downward.		
a) Releases brake lock while holding brake lever.	Prepare to release brake.	Brake lever location and function.
b) Places foot on deadman switch.	To assure that hoist will stop if operator is incapacitated.	Deadman switch location and function.
c) Releases hand brake slightly	To allow drum to move slowly for descent.	Brake operation

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ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
d) Observes cam indicator.	To determine when to accelerate.	Depth indicator location, function and markings.
e) When indicator passes cam, releases hand brake to second position.	Start acceleration	Brake operation.
f) Observes drum revolutions for proper descent speed by gravity.	Allow drum to accelerate	
1) Rotate controller counter-clockwise to 10.	Hold drum speed to cruising speed.	Appearance of drum at cruising speed. Controller operation.
2) Release hand brake completely.		
7. Operates hoist controls to decelerate/stop descending trip.		
a) Monitors depth indicator	To determine when cage is nearing destination	Location and markings on depth indicator.
b) Hears warning bell		Warning Bell System
1) Pull Hand Brake while observing depth indicator	To slow descent	Brake operation
2) Rotates power control clockwise to 1.	Remove power from motor	Controller operation
c) When indicator is 1" from 1300' notch, observe drum.	Prepare to stop.	Drum markings.

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
d) when 1300' mark touches outside mark, pull brake all the way.	To stop descent	Brake operation
e) Steps off deadman switch	To turn off hoisting power	Functions of controller and deadman switch.
f) Returns motor controller to neutral.		

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TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE I - SERVICE
SINGLE LEVEL MINE; SINGLE DRUM HOIST; NO CLUTCH; MANUAL
OPERATION: *C. End of Shift Safety Check.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Test overtravel top and bottom in all 3 shifts (let hoist creep past maximum points; if OK, will stop, then step on overtravel by-pass and deadman switch to release)		Overtravel and overspeed devices, location and operation.
2. Overspeed (every shift) (release by putting motor control to neutral and step on deadman switch)	Check overspeed trips.	
3. Communications (every shift) (battery phone, foot activator; if not OK, shut down)	Check communications.	Communication system.
4. Safety dogs on cage.	Check safety dogs on cage.	Slack rope device.
a) lower 1/4 speed (with supervisor on board) into sump		
b) dogs supposed to open		
c) supervisor will call if do not open, must shut down.		Communication system.
5. Lubrication checks.	Assure that hoist is lubricated.	
a) Gear box	Assure that gears are lubricated.	
1) see if gears are well coated.		Sight hole for gears.

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
2) pour oil in window if not well coated (1/2 gallon)		Oil type used for gears.
3) run motor for awhile and recheck.		
b) Bearings (motor, shaft, depth indicator gearing)	Assure that bearings are lubricated.	Bearing dip sticks, depth indicator greasing.
c) Rope:		
1) Look to see if rope is wet	Assure that rope is lubricated.	Appearance of dry/well lubricated rope.
2) If rope is dry, call maintenance supervisor.	Obtain assistance	Location and identity of maintenance supervisor.
6. Depth indicator check		
a) Run the hoist so that the depth indicator is at the bottom (or the top) position.	Check alignment of depth indicator with hoist.	Hoist operation.
b) Have a man check to see that the cage is at the indicated position.		Communication system and procedure.
1) If not, adjust the marker so that the cage is in the position indicated.	Bring depth indicator into alignment with hoist.	How to adjust depth indicator.
c) Repeat for top (or bottom) position.		

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ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
7. Evacuation procedures	Prepare for emergencies.	
a) Stop hoist	Stop production hoist.	Production hoist controls, the location and function.
b) Clear mill (mill supervisor)	Mill is ordered cleared.	
c) Bring cage to 1300' level and wait for call.	Hoist is available to bring men out.	Communication system.

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TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE J - SERVICE
SINGLE LEVEL MINE; SINGLE DRUM HOIST; NO CLUTCH; MANUAL
OPERATION: *A. Inspect Hoist at Start of Shift.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Cage is in "release" (below collar slightly)		Hoist operation/function.
2. Talk to previous hoistman.	To determine any problems in previous shift.	Hoist operating procedures.
3. Raise hoist past collar slowly 4'-8'. Power should go off and brakes set automatically.	To check top hoist notches.	Function of top and bottom notches.
a) If equipment working properly, steps on dead-man switch and lowers cage.		Location and operation of deadman switch.
b) If equipment is not working properly, stops and calls mechanic.	To obtain assistance.	Communication system; identity and location of maintenance personnel.
4. Lowers hoist 6'-8' below last station. Same as for top hoist notch.	To check bottom hoist notch.	Function of top and bottom notches.
5. Puts hoist controls into neutral, brakes off; lets cage coast about 15 seconds.	To test overspeed control.	Location and function of hoist and brake controls.
a) If equipment working properly, power goes off and brake sets.		
b) If overspeed is not working properly, pulls brake lever back gradually until stopped; sets both brakes; shuts power off and calls mechanic.	To stop hoist with brakes and obtain assistance.	Brake operation; location and identity of maintenance personnel.

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
6. Oil Lilly		Location and identity of item to be oiled; and of items which must <u>not</u> be oiled.
a) Squirts a few drops on all moving parts with oil can; also on brake operating mechanisms.	To lubricate Lilly and brake mechanisms.	Type of oil to use and where it is stored.
7. Looks at dripolator on drum bearings (sight glass)	To see if oil is low.	Appearance of normal condition of dripolator sight glass.
a) If level very low, adds oil to fill reservoir.	To replenish oil supply	Type of oil, storage location, filling procedure.
b) Oil drum shaft only; not motor gears.	To lubricate drumshaft	Oiling procedure.
8. Checks for loose bolts.	Assure solid mounting.	Appearance of loose bolts.
9. Checks for oil leaks.	To report to maintenance and have repaired.	Appearance of oil leaks.
10. Visually examines rope.	To report broken strands and shiny spots that need maintenance.	Appearance of normal and of worn rope.

TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE J - SERVICE
SINGLE LEVEL MINE; SINGLE DRUM HOIST; NO CLUTCH; MANUAL
OPERATION: *B. Operate the Hoist.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Carry men to working level.		
a) Brings cage from "release" position to collar.		Location and function of hoist controls and brake controls.
1) by self or voice page from cager		Communication procedure and systems.
b) Receives bell code to stop	Cage is at collar.	Bell code.
c) Hears signal to lower.		Bell code.
d) Pulls brake back slowly watching and listening to drum (about 1/2 of travel)	Release brake so that drum can begin to accelerate.	Brake operating procedure.
e) When drum reaches "right" speed:		
1) Squeezes controller release lever and pulls back to 1st position (total of 6)	Apply power as needed to control speed.	Function and operation of controller.
2) Listens to drum and when at right speed, pulls to 2nd notch, then 3rd until 6th position is reached.		
241 3) Operator could wait for drum to go to maximum speed and pull back all the way from 1 to 6.	Full power is applied.	242

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
f) Watches depth indicator	To ascertain when pointer reaches "right" position.	Location and markings of depth indicator.
g) Decelerates	To slow the speed of descent.	
1) Pull brake about 1/2 way.	Begin to apply brake.	Location and operation of brake control.
2) Puts power controller to neutral.	Take off power.	Location and function of controller.
3) Watches drum (and indicator) marks.	To determine when level is reached.	Location and markings of indicator.
4) Pull back on brake watches drum.	To bring cage to creep speed.	Brake operation.
5) Receives bell signal	To stop cage descent	Bell code.
6) Pull brake lever to full.		Brake operation
a) If no bell signal received	Indication of problem.	
1) will let cage creep all way past the level (one round on drum past stop mark).	Assure that cage passes level.	Standard procedures.
2) stop cage and page the cager	Determine problems	Communication system and procedure.
3) if no answer, will raise at creep speed past level (one round on drum) and stop.		Hoist operating procedures

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ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
4) will call cage again		
5) if no answer, will bring cage to collar; stop; and investigate.		
2. Raise hoist from work level.		
a) Receives bell signal	Instruction to raise cage.	Bell code, communication procedure
b) Moves motor controller to 4th notch.	Apply power to start cage.	Motor control function.
c) Push brake all the way off	Release brake	Brake operation.
d) Moves controller to 6th position.	Apply full power	Motor control function
e) Monitors depth indicator	To determine when depth indicator is approaching collar.	Location and marking of depth indicator
1) Pulls power control to 4th position.	Slow hoist	Motor control function
2) Pull brake about 1/2 way.	Begin to slow.	Brake operation.
3) Gradually pull brake	To bring cage to creep speed.	
f) Receives bell signal.	To indicate have reached collar.	Bell code.
1) Simultaneously pull brake to full on and move motor control to neutral	Stop hoist.	Brake and motor control operation.

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ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
2) If no bell signal to stop		
a) watch drum	To determine when collar mark reached.	Marking on drum.
b) when hoist reaches collar, stop anyway	Stop	Brake and motor control operation.
Note: procedure for decelerating and stop (on hoist) between levels is same as to collar.		
3. Operating hoist which has been off from prior shift.		
a) Run cage all the way up and down.	To make sure shaft is clear.	Hoist operation

TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE J - SERVICE
SINGLE LEVEL MINE; SINGLE DRUM HOIST; NO CLUTCH; MANUAL
OPERATION: *C. End of Shift Activities.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Put cage in an inaccessible place.	Prevent unauthorized entry.	Hoist operation.
2. Put power to neutral.	Hold cage stationary.	Standard Operating Procedures.
3. Brakes are set		
4. Inform relief man that cage is "released."	Inform relief of overall status.	
5. Inform relief man about any problems.		

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TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE K - SERVICE/PRODUCTION
MULTI- LEVEL MINE; SINGLE DRUM HOIST; NO CLUTCH; MANUAL
OPERATION: *A. Inspect Hoist at Start of Shift.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Visually checks wiring.	To locate burnt ends, loose connections in need of maintenance.	Visual appearance of good wiring vs. bad wiring. Location of critical wiring.
2. Checks brakes visually and hoist housing for loose bolts; (raised nuts); scored points.	Identify mechanical defects in brakes.	Visual appearance of defects; appearance of good brake mechanisms.
3. Examines skip/rope coupling from hoist house.	To check for obvious loose connectors.	Visual appearance of good rope/ connection conditions vs. appearance of poor ones.
4. Checks safety cable on top of skip.	Assure safety cable is correct.	Visual appearance of good vs. bad safety cable.
a) If slack OK		
b) If taut, not OK, call supervisor.	Obtain assistance	Location and identity of supervisor.
5. Test hoist operation.		
a) Turns power on at panel	Energize system.	Location and operation of power switch.
b) Runs one empty trip down and up.	To inspect operations.	Motor and brake controls.
c) Test overspeed--bottom only	Assure operation of safety devices.	Test procedures for safety devices.
d) Test overtravel--top only		
6. Enters info in log book		
a) Fills in any problems	Record conditions	Logging procedures.
b) Enters inspection report.		

TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE K - SERVICE/PRODUCTION
MULTI-LEVEL MINE; SINGLE DRUM HOIST; NO CLUTCH; MANUAL
OPERATION: *B. Operate the Hoist.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Lower empty skip.		
a) Push motor control lever all the way (5th notch); release brake.	Start skip moving.	Operation and function of motor and brake controls.
b) Watch depth indicator	To determine position of skip.	Location and markings on depth indicator.
1) When pointer approximately 6" from mark, push to 6th position.	To slow skip.	
2) When pointer is about 4" from mark, motor control lever pushed past neutral to 1st point of hoist range.	Reverse motor.	Operation of motor control.
3) When pointer is about 2" from mark, operator begins easing brake back (pull)	To attain "creep" speed.	Operation of brake control.
4) When pointer is on mark operator pulls brake back all the way and puts controller to neutral.	Stop and hold skip.	Operation of motor and brake control.
2. Raise skip (with coal)		
a) Receives bell signal.	Instruction to raise skip.	Bell code and communication procedures.
b) Pulls motor control lever to 4th notch.	Apply power to motor, and allow skip to move.	Motor and brake control operation and function.

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
c) Releases brake (push)		
d) Pulls motor control lever to 5th notch.	Increase power.	
e) Watches ammeter	Prevent electrical overload.	Location and function of ammeter.
1) if normal load, pulls motor control lever back to 6th position		Permissible motor load.
2) if heavy load, pulls to 6th, push back to 5th and repeat	To adjust speed until ammeter reads 750	Arrive at cruising load.
3. Decelerate and stop on raise		
a) Watches depth indicator	To determine when 3" from top mark.	Location and marking on depth indicator.
1) push motor controller to 4th point.	Reduce power	Motor control functions.
2) when point is at top mark, push motor controller to 3	Reduce power further.	Motor control functions.
b) Looks forward through hoist house window	To observe skip.	Appearance of skip when at the stop position.
c) When bottom of trip clears top of dump (and trip opens) moves power controller back and forth between 3 and 4.	Reduce power further. To hold stationary until trip is empty.	Motor control function
d) When nearly empty, push to 3rd notch	To keep lightened trip from going to overtravel.	Motor control function
e) When trip empty and door closes; push all the way (6th notch)	To lower trip	Motor control function

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
4. Lower men from top.		
a) Receives bell signal	Instruction to lower skip.	Bell code and communication procedure.
b) Puts power to neutral.	Apply no power	Motor control function.
c) Push brake to off	Release brake	Brake control function
d) After 1-2 seconds, push power to 6.	To keep maximum speed down.	Motor control function.
e) Monitors depth indicator	To determine position of man-trip.	Location and markings on depth indicator.
f) When approximately 4" from marker for main level, pull power controller to 1st position in hoist range.	Reverse power to slow hoist.	Motor control function.
g) Intermittently apply brakes.	To make trip creep	Brake control functions.
h) When drum marks for man trip touch reference mark, pull brakes full.	Stop trip with brake.	Brake control functions.
i) power to neutral.	Apply no power	Motor control functions.
5. Raise men		
a) Push power controller to 6th notch; release brake	Apply power and release brake to start man-trip moving.	Brake and motor control functions.
b) Push power controller to 3rd notch when 4" from collar mark on depth indicator.	Reduce power.	Motor control functions.
c) When indicator mark is at the bottom of the green area, gently apply brake.	To slow man-trip	Brake control function.

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
d) Monitors drum	Determine position of trip.	Markings on drum.
e) When man mark reaches reference mark on drum push brakes to full	Stop trip	Brake control function
f) Power to neutral	Apply no power	Motor control function

TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE K - SERVICE/PRODUCTION
MULTI-LEVEL MINE; SINGLE DRUM HOIST; NO CLUTCH; MANUAL
OPERATION: *C. End of Shift Activities.*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Informs relief hoistman of any problems encountered or power drain.	Pass along information of hoist condition.	General hoist condition.
2. Moves skip to top of mine.	Get skip clear of landing	Brake and motor control function.
3. Puts brake on full	Stop skip	
4. Puts power to neutral	Cut power to motor	
5. Leaves hoist house to go to panel and turns power switch to off.	Cut power to distribution board.	Location and operation of power switch.

TASK ANALYSIS/SKILL AND KNOWLEDGE REQUIREMENT – MINE A through K
LEVEL MINE; HOIST; CLUTCH:
OPERATION: *Inspect Wire Rope*

ACTION/BEHAVIOR	PURPOSE	SKILL/KNOWLEDGE REQUIREMENT
1. Wrap waste/rags around wire and tell operator to run hoist at 50'/min. for a given distance (200' for example).	To determine if any wires are broken.	Rope speed for rag test -- Federal/ State regulations; communication system and procedures. Distance between samplings -- company policy. Frequency of test -- company policy.
2. When hoist stops; clean off the lubricant for a length of one lay of the rope.	To prepare the rope for measurement of crown wear and rope diameter.	Type of solvent; solvent location. Definition of "lay of rope."
a) Measure the length of the crown wear on a single strand.	To determine the extent of crown wear on a single strand.	Appearance of crown wear.
b) Measure the diameter of the rope.	To determine if the rope diameter has changed appreciably since the last test.	How to measure rope diameter, i.e., "Crown to Crown". How to use calipers.
c) Measure the length of one lay of rope.	To determine if the rope has stretched.	Definition of "lay of rope"
3. Record the readings from 2a, b, and c above. Forward data to engineering office.	To provide a basis for comparison from one test to another.	Record keeping requirements.
4. Repeat steps 1-3 above.		

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